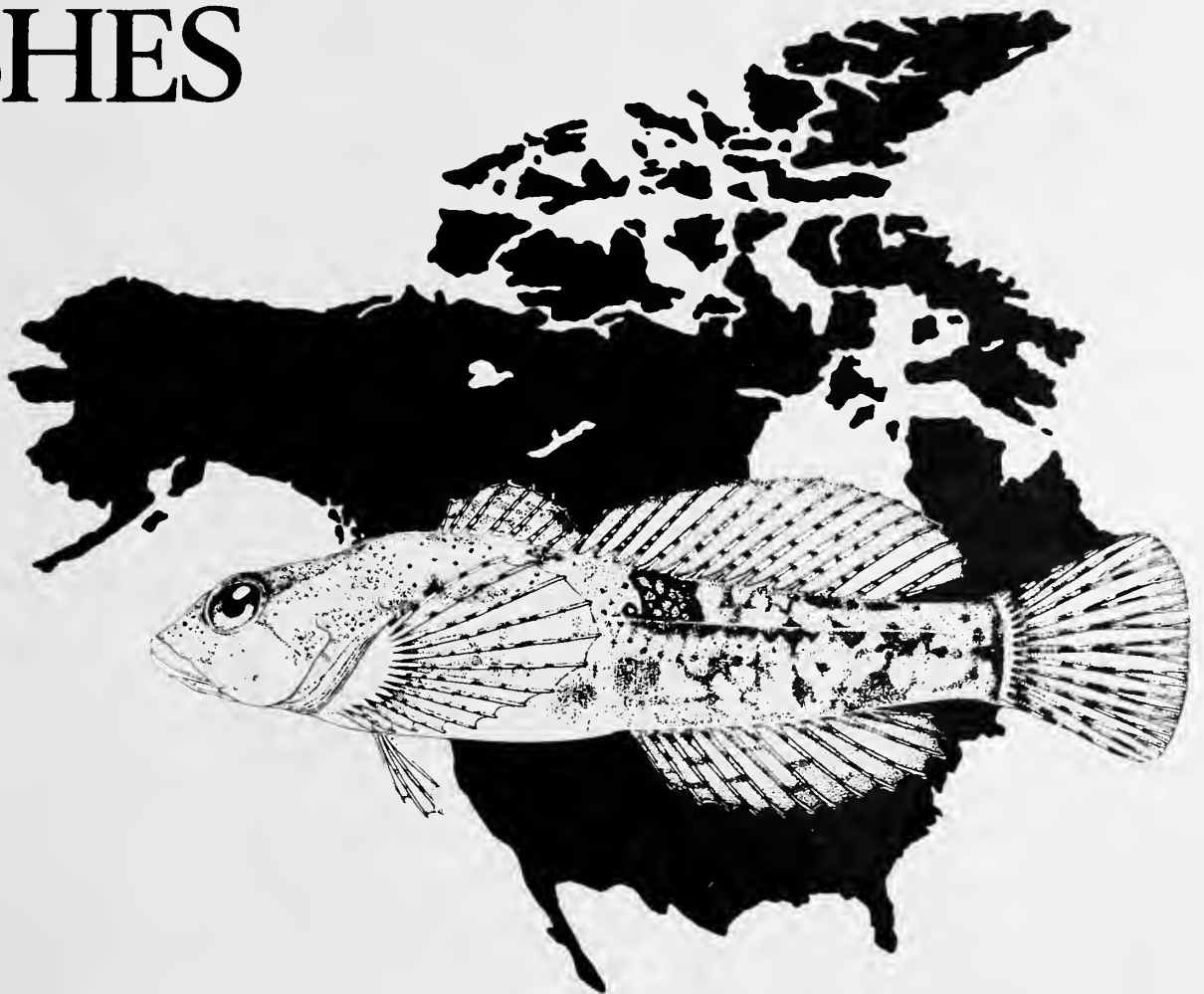




ATLAS OF NORTH AMERICAN FRESHWATER FISHES



LEE
GILBERT
HOCUTT
JENKINS
McALLISTER
STAUFFER





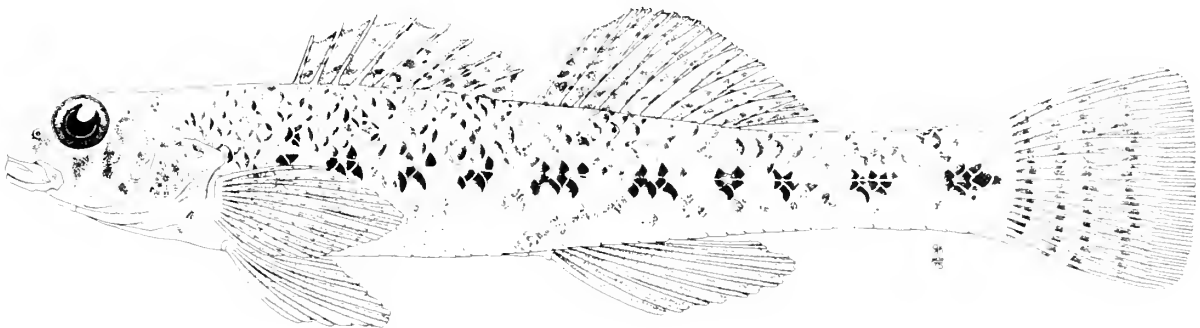
ATLAS OF NORTH AMERICAN FRESHWATER FISHES

1980 - et seq.

David S. Lee
Carter R. Gilbert
Charles H. Hocutt
Robert E. Jenkins
Don E. McAllister
Jay R. Stauffer, Jr.

with special thanks to:

George Burgess
James A. McCann
Steven P. Platania



We had originally intended that this volume be a collection of loose leaf pages. However since the additional cost was not large, and we were able to retain loose leaf format for those interested in adding and replacing pages, we decided to have it bound. This necessitated a short delay in production.

Library of Congress Cataloging in Publication Data

Lee, David Stephen, 1943-
Atlas of North American freshwater fishes.

Bibliography: p.

1. Fishes, Fresh-water--North America--
Geographic distribution. 2. Fishes--
Geographic distribution. 3. Fishes--
North America--Geographic distribution.

QL625.A84 597.092'97 80-620039

ISBN 0-917134-03-6

1st printing

October 1980

2nd printing

November 1981

Publication #1980-12 of the North Carolina Biological Survey

Copyright 1980 by North Carolina State Museum of Natural History
All rights reserved

North Carolina State Museum, John B. Funderburg, Director

North Carolina Department of Agriculture, James A. Graham, Commissioner of Agriculture.

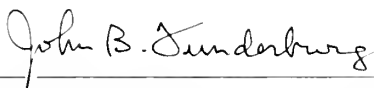
FOREWORD

This atlas attempts to summarize available distributional information on all the freshwater fishes of the United States and Canada, and to provide some information on their biology. Although the many needs for such a volume have long been obvious, only in the last few years has a work of this nature been feasible. The large number of regional faunal works that have recently appeared, the publication of cumulative locality records, and the expansion of museum and other ichthyological collections provide extensive and reasonably complete data for most North American species. Thus, a "first approximation" atlas is now possible.

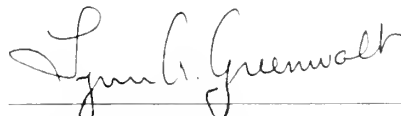
The desirability of this compilation is perhaps best attested to by the large number of individuals from many agencies and institutions in both countries who volunteered their services to make it a reality. Probably no other single zoological work has been so willingly supported by such a wide spectrum of enthusiastic contributors. We anticipate that the atlas will be useful in studies of biogeography, systematics, and ecology, and to persons involved in fisheries management and environmental assessment. It should also be quite important to educators, and to fishermen and general outdoorsmen in the United States and Canada.

The Introduction cautions that the atlas is not to be considered definitive. In fact, one of the publication's major contributions may be to show where voids exist, thus stimulating the ichthyological community to fill in major gaps in our understanding of North America's freshwater fishes. The atlas also will make it possible for collectors with relatively limited training in ichthyology to recognize new and potentially significant locality records, and perhaps to determine whether observations on behavior and other aspects of the natural history of fishes are noteworthy. We encourage such workers, and others who possess new information, to deposit voucher specimens in established museums or other curated collections. Because the information base herein provided calls attention to deficiencies in our knowledge, that knowledge might consequently grow at an accelerated rate.

The primary authors and major collaborators of the atlas are to be congratulated for recognizing the need for such a volume, and for undertaking the horrendous task of distilling a large and highly fragmented body of data into a useful document. Similarly, the many persons who unselfishly contributed to its completion are to be highly commended.



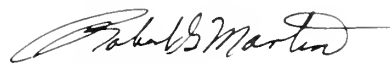
John B. Funderburg
Director, North Carolina State Museum
of Natural History



Lynn A. Greenwalt
Director, U.S. Fish and Wildlife
Service



Louis Lemieux
Director, National Museum of
Natural Sciences, Ottawa, Canada



Robert G. Martin
Assistant Executive Vice President
Sport Fishing Institute



Richard H. Stroud
President, American Fisheries Society

This volume would not have been attempted without the prior commitment of assistance from a number of researchers and agencies, and it certainly could not have been completed without the hard work, dedication, and perseverance of many people. Acknowledgments are grouped into several subsections of endeavor, all of them equally important to completion of the project:

FINANCIAL.—Funding for most of the technical support and some travel expenses came from U.S. Fish and Wildlife Service contract number 14-16-0009-78-018 (to NCSM). This contract was through the service's National Fishery Research Laboratory in Gainesville, Florida. We thank its Director, James A. McCann, for his support of the atlas and his endless patience with our requests for extensions and contract modifications. Assistance from F. Eugene Hester, Associate Director of Research and Galen L. Buterbaugh, Associate Director of Fisheries was critical to obtain funding support of the project. Compiling of the data on exotic fishes, done by Walter R. Courtenay, Jr., was also funded by this office. We particularly thank the Sport Fishing Institute for additional funding to help offset cost of illustration preparation and reduction. The North Carolina State Museum, a division of the N.C. Department of Agriculture, contributed nearly all overhead expenses and indirect costs connected with preparation of the atlas. Thanks to these three sources of volunteer help from individuals and institutions, the comparatively low price of this volume reflects only the cost of typesetting, printing, and distribution.

TECHNICAL.—An asterisk (*) indicates full or partial support by U.S. Fish and Wildlife Service. The following people worked fulltime on the atlas: Steven P. Platania* (1977 to present); Alice W. Allen-Grimes* (1978-1980); J. Randy Shute* (1977-1978); and Kathleen Wade* (1977-1978; parttime 1978 to present). In addition, the following people provided part-time technical assistance; Eloise F. Potter*, Steven Kucas, Mary Kay Clark, Kathy Harrington, Walter Pursley, Laura Mansburg*, Laura Lee Burton*, David Ballard, Tessy Brungardt, Mary Funderburg, Othell Price, and Fred C. Rohde *.

ILLUSTRATIONS.—Many of the illustrations are original. Most were done by Renaldo Kuhler, scientific illustrator at the North Carolina State Museum. The many nights and weekends of unpaid overtime that he devoted to this project are gratefully acknowledged. The few other "NCSM" illustrations are either drawings done by Alice W. Allen-Grimes and John E. Cooper, or photographs of dubious quality done by Steven Platania and Dave Lee. Duane Raver (N.C. Wildlife Resources Commission) made the illustrations of various game species marked "N.C. Wildlife Resources Commission/NCSM." Many atlas contributors provided the specimens that were illustrated.

Additional major sources of illustrations were the U.S. National Museum of Natural History (from Jordan and Evermann 1900 [Reprinted by permission of the Smithsonian Institution Press from "The Fishes of North and Middle America." D. S. Jordan and B. W. Evermann, *Bulletin of the United States National Museum*, Number 47, Part IV. Washington, D.C. Government Printing Office, 1900]); the National Museums of Canada; Peter B. Moyle, University of California at Davis; Florida Atlantic University; William L. Pflieger, Missouri Department of Conservation (photos by Don Wooldridge and James R. Whitley and artwork by Shirley Abbott); William F. Smith-Vaniz, Academy of Natural Sciences of Philadelphia; John L. Harris and Richard T. Bryant, Jr., University of Tennessee at Knoxville; and Ira LaRivers' *Fishes of Nevada*. Illustrations from *The Fishes of Illinois* are copyrighted (1979) by the Board of Trustees of the University of Illinois.

Other than compilers, people and institutions providing one or more illustrations whose source is not entirely obvious from the credit line are:

Faith Birkhead
Division of Science and Math
Columbus College
Columbus, GA 31907

D. M. Sutherland
The University of Nebraska at Omaha
Box 688
Omaha, NB 68101

W. W. Hunt
P. O. Box 1201
Highlands, NC 28741

A. E. Spreitzer
Ohio State University
Museum of Zoology
1813 N. High Street
Columbus, OH 43210

All illustrations credited to the NCSM may be used by anyone desiring them. Credit should be cited to the NCSM. Persons interested in their use should contact Lee. Copies from the originals will be provided on an at-cost basis.

COMPILERS.—The names of compilers appear at the bottom of each account, and their addresses can be found on pages 849-854. Their contributions cannot be overpraised. They were the backbone of this volume, and their enthusiasm and dedication were sources of continual encouragement. Most also served as reviewers and many supplied additional information and specimens.

REGIONAL REVIEWERS.—The following people provided useful information for many species occurring in their areas. Many provided considerable amounts of personal unpublished data, and each reviewed various maps and accounts as requested: Alabama, Herb Boschung, William Smith-Vaniz; Alaska, James Morrow; Arizona and Southwest, William Minckley; Arkansas, Henry Robison; California, Peter Moyle, Camm Swift; Colorado, Robert Behnke; Delaware, Dave Lee; Florida, Carter Gilbert; Idaho, Richard L. Wallace; Kentucky, Brooks Burr; Louisiana, Neil Douglas; Maryland, Dave Lee; Massachusetts, Karsten Hartel, James Hoff; Mississippi, Glenn Clemmer; Missouri, Bill Pfleiger; Nebraska, Richard Stasiak; New Jersey, Bob Hastings; New York, C. Lavett Smith; North Carolina, Ed Menhinick, Bill Palmer; North Dakota, Dean Elsen; Oklahoma, Henry Robison; Oregon, Carl Bond; Pennsylvania, Edward L. Cooper; South Carolina, Harold Loyacano; South Dakota, Charles Scalet; Tennessee, Dave Etnier, Wayne Starnes; Texas, John McEachran; Utah, Paul Holden; Virginia, Robert Jenkins; Washington, Carl Bond; West Virginia, Jay Stauffer, Charles Hocutt; Wisconsin, George Becker; and Great Lakes area, Harry D. Van Meter. Larry Page reviewed most darter maps.

BASE MAPS.—Most of the maps used in this volume are plotted on drainage maps of the United States or Mexico purchased from the University of Michigan (Office of the Secretary, Museum of Zoology, University of Michigan, Ann Arbor, MI 48109). The Canada and Alaska portion of the base map was prepared by various personnel and students at the Florida State Museum, and the Canadian portion contains some errors. Most were the result of matching projections of the two maps, and we hope to correct them in future revised accounts. Other maps were provided by the University of Alabama (Mobile Bay basin), University of Florida (Florida, Maryland, North American outline map), University of Idaho (Idaho), Museum of Zoology, University of California at Berkeley (California), National Museums of Canada (Northern Hemisphere), and North Carolina State Museum (world).

PRINTING AND PHOTOREDUCTION.—Marvin Pollard, Mary Kay Clark, and Charles Cross photographically reduced most of the maps and illustrations. Alexa Williams, N.C. State Museum, served as liaison between the atlas staff and the various printshops in Raleigh.

MUSEUMS FROM WHICH RECORDS WERE OBTAINED.—Academy of Natural Sciences, Philadelphia, American Museum of Natural History, Arizona State University, Appalachian Environmental Laboratory, Auburn University, California Academy of Sciences, Charleston Museum, Clemson University, Colorado State University, Cornell University, DePaul University, Duke University, Field Museum of Natural History, Florida Atlantic University, Florida State University, Georgia State College, Atlanta, Illinois Natural History Survey, Indiana State University, Indiana University, Jacksonville University, Mississippi State Museum, Mississippi State University, Missouri Conservation Commission, Museum of Comparative Zoology, Mississippi State Wildlife Museum, Natural History Museum, Los Angeles County, National Museums of Canada, National Museum of Natural History, North Carolina State Museum, Northeast Louisiana University, Ohio State Museum, Oklahoma Fisheries Research Laboratory, Norman, Oklahoma State University, Oregon State University, Quebec Wildlife Service, Montreal, Roanoke College, Royal Ontario Museum, Southern Arkansas University, Stanford University, State University of New York at Buffalo, Tennessee Valley Authority, Texas A & M University, Tulane University, University of Alabama, University of British Columbia, University of Florida, University of Georgia, University of Kansas, University of Kentucky, University of Louisville, University of Michigan Museum of Zoology, University of Minnesota, University of Missouri, University of New Mexico, University of North Carolina at Charlotte, N.C. Division of Marine Fisheries, University of Oklahoma, University of Richmond, University of South Alabama, University of Tennessee, University of Texas, University of West Florida, University of Wisconsin at Steven Point, Virginia Commonwealth University, Virginia Institute of Marine Sciences, Virginia Polytechnic Institute, Wilfrid Laurier University, Wisconsin State University.

This is a partial listing and does not imply that records of entire collection holdings were available or that records available were used. The curators of these collections and other support staff often spent considerable amounts of time locating and verifying specimen records. Curators of large collections were occasionally burdened with multiple request. We appreciate their help.

DISTRIBUTION RECORDS AND OTHER INFORMATION.—The assistance of the following people and institutions in supplying various information as requested is greatly appreciated. It should be pointed out that nearly all of the compilers and regional reviewers also assisted in many other ways, but in interest of space, we will not repeat their names here.

William D. Anderson
Grice Marine Biological Laboratory
Charleston, SC

Rudolph G. Arndt
Stockton State College
Pomona, NJ

James K. Andreason
U.S. Fish and Wildlife Service
Victoria, TX

F. M. Atton
Saskatchewan Fisheries Laboratory
Saskatoon, Saskatchewan

Jadwiga Aniskowicz
National Museums of Canada
Ottawa, ON

Reeve M. Bailey
Museum of Zoology
University of Michigan
Ann Arbor, MI

Willard E. Barber
University of Alaska
Fairbanks, AK

Robert L. Bounds
Texas Parks and Wildlife Department
Austin, TX

Eugene H. Buck
Arctic Environmental Information
and Data Center
Anchorage, AK

Labbish Ning Chao
Fundacao Universidade do Rio Grande
Base Oceanografica Atlantica
Brasil

Barry Chernoff
Museum of Zoology
University of Michigan
Ann Arbor, MI

W. J. Christie
Glenora Fisheries Station
Picton, ON

John Van Conner
School of Forestry and Wildlife
Management
Louisiana State University
Baton Rouge, LA

D. Copeman
Memorial University
St. John's, NF

M. Dadswell
Huntsman Marine Laboratory
St. Andrews, NB

Vince DeMarco
Texas Christian University
Fort Worth, TX

Allan Dietemann
Maryland Water Resources Administration
Annapolis, MD

Allan Emery
Royal Ontario Museum
Toronto, ON

James Felley
University of Oklahoma
Norman, OK

S. W. Gorham
New Brunswick Museum
St. John, NB

Gene S. Helfman
University of Georgia
Athens, GA

Bill Helm
Utah State University
Logan, UT

George Heufelder
University of Michigan
Ann Arbor, MI

James G. Hoff
Southern Massachusetts University
North Dartmouth, MA

J. G. Hunter
Fisheries and Marine Service
Ste. Anne de Bellevue, QU

Buddy Lee Jensen
U.S. Fish and Wildlife Service
Dexter, NM

Margaret Jones
Arctic Biological Station
Ste. Anne de Bellevue, QU

J. Ralph Jordan, Jr.
Tennessee Valley Authority
Norris, TN

Vianne Legendre
Ministere du Loisir, de la chasse
et de la peche
Montreal, QU

William H. LeGrande
University of Wisconsin
Stevens Point, WI

C. C. Lindsey
University of British Columbia
Vancouver, BV

William F. Loftus
Everglades National Park
Homestead, FL

W. Lowe and Staff of the Reference Section
at D. H. Hill Library, NCSU
Raleigh, NC

Albert Marmelstein
U.S. Fish and Wildlife Service
Washington, DC

Robert F. Martin
Texas Memorial Museum
University of Texas at Austin
Austin, TX

Edward R. Matheson
Texas A & M University
College Station, TX

Peter McCart
Aquatic Environment Ltd.
Calgary, AT

James D. McClure
University of Maine
Orono, ME

Mike McCoid
Texas A & M University
College Station, TX

John D. McEachran
Texas A & M University
College Station, TX

Robert R. Miller
Museum of Zoology
University of Michigan
An Arbor, MI

David L. Miller
Colorado State University
Fort Collins, CO

Carol Mitchell
University of Michigan Press
Ann Arbor, MI

Jeane-Rene Mongeau
Service de l'Amenagement et de l'Exploration
de la Faune
Region de Montreal
Montreal, QU

J. S. Nelson
University of Alberta
Edmonton, AT

Alex Peden
British Columbia Provincial Museum
Victoria, BC

Duane Raver
North Carolina Wildlife Resources
Commission
Raleigh, NC

Luis R. Rivas
National Oceanic and Atmospheric
Administration
Miami, FL

C. Richard Robins
Marine Laboratory
University of Miami
Miami, FL

Al Sanders
Charleston Museum
Charleston, SC

Robert E. Schmidt
Fordham University
Armonk, NY

Frank J. Schwartz
University of North Carolina
Morehead City, NC

Donald C. Scott
University of Georgia
Athens, GA

Monte Seehorn
U.S. Forest Service
Atlanta, GA

Philip W. Smith
Illinois Natural History Survey
Urbana, IL

William Smith-Vaniz
Philadelphia Academy of Natural Sciences
Philadelphia, PA

John Stanley
University of Maine
Orono, ME

Michele Steigerwald
National Museums of Canada
Ottawa, ON

James E. Sublett
Eastern New Mexico University
Portales, NM

James Suhmulback
University of South Dakota
Vermillion, SD

Roger Weill
Mississippi Museum of Natural Science
Jackson, MS

Paul Turner
New Mexico State University
Las Cruces, NM

James D. Williams
U.S. Fish and Wildlife Service
Washington, DC

Harold Tyus
U.S. Fish and Wildlife Service
Vernal, UT

N. J. Wilmovsky
University of British Columbia
Vancouver, BC

George Van Dyke
National Museum of Natural History
Washington, DC

R. Winterbottom
Royal Ontario Museum
Toronto, ON

W. S. Woolcott
University of Richmond
Richmond, VA

OF PARTICULAR IMPORTANCE.—Particular thanks are due Steven Platania, Alice Allen-Grimes, and Randy Shute for the long hours they spent on this project. Jim McCann and John B. Funderburg are to be thanked for eliminating or deflecting administrative red tape so it would not increase our burden. George Burgess did the bulk of the work on the marine and estuarine species.

Finally, we want to thank John E. Cooper, N.C. State Museum, for the time and energy he spent on the atlas. He edited and proofread everything in the atlas, some of it several times, and rewrote much of what appears here. In addition, he provided advice and encouragement during the formative stages of the project, and kept the atlas on track when others were pressuring to increase its magnitude. For his unflagging support and generous assistance, this atlas is dedicated to him.

TABLE OF CONTENTS

	Page
Foreword	<i>iii</i>
Acknowledgments	<i>v</i>
Introduction	4
Petromyzontidae - lampreys	15
Carcharhinidae - requiem sharks	36
Dasyatidae - stingrays	37
Acipenseridae - sturgeons	38
Polyodontidae - paddlefishes	45
Lepisosteidae - gars	47
Amiidae - bowfins	53
Elopidae - tarpons	55
Anguillidae - freshwater eels	59
Clupeidae - herrings	61
Engraulidae - anchovies	73
Hiodontidae - mooneyes	74
Salmonidae - trouts	76
Osmeridae - smelts	121
Umbridae - mudminnows	127
Esocidae - pikes	131
Characidae - characins	139
Cyprinidae - minnows	140
Catostomidae - suckers	367
Cobitidae - loaches	436
Ictaluridae - bullhead catfishes	437
Clariidae - airbreathing catfishes	475

Ariidae - sea catfishes	476
Loricariidae - armored catfishes	477
Amblyopsidae - cavefishes	478
Aphredoderidae - pirate perches	484
Percopsidae - trout-perches	485
Gadidae - codfishes	487
Belonidae - needlefishes	489
Oryziatidae - medakas	490
Cyprinodontidae - killifishes	491
Poeciliidae - livebearers	537
Atherinidae - silversides	557
Gasterosteidae - sticklebacks	561
Syngnathidae - pipefishes	567
Centropomidae - snooks	569
Percichthyidae - temperate basses	573
Centrarchidae - sunfishes	577
Percidae - perches	615
Carangidae - jacks	749
Lutjanidae - snappers	750
Gerreidae - mojarras	751
Pomadasyidae - grunts	753
Sparidae - porgies	754
Sciaenidae - drums	756
Ephippidae - spadefishes	762
Cichlidae - cichlids	763
Embiotocidae - surfperches	776
Mugilidae - mullets	778
Eleotridae - sleepers	781

Gobiidae - gobies	785
Belontiidae - gouramies	799
Cottidae - sculpins	800
Bothidae -lefteye flounders	828
Pleuronectidae - righteye flounders	830
Soleidae - soles	831
Glossary	833
Appendix A	837
Appendix B	849
Index	855

INTRODUCTION

In 1973, along with several other workers, I started trying to determine the precise distributions of the 105 species of "freshwater" fishes known to occur in Maryland and Delaware. Our collecting efforts and those of our predecessors produced a relatively complete picture of the distributions of these fishes. Unfortunately, however, there was little other distributional information to which the data could be related for larger zoogeographic purposes. At that time Connecticut was the only Atlantic slope state whose total fish fauna had been mapped. The distributions of certain species had been delineated by various investigators (e.g., *Notropis amoenus*, Snelson 1968. Copeia: 776-802), but those species represented a small percentage of the regional fauna. In addition, while general "blackout" maps appeared as insets on larger scale maps in such books as *The Fishes of Ohio*, *Freshwater Fishes of Canada*, and Pflieger's 1971 distributional study of Missouri fishes, they did not include a majority of Atlantic slope species, and were incomplete for most.

I next turned to plotting the general distributions of all species that occurred in Maryland and Delaware, and in this I had the eager help of Carter Gilbert, who later became one of the primary authors of this atlas. Fortunately, Carter already had compiled a wealth of unpublished records. During the late 1960s, with the aid of a National Science Foundation grant, he had examined major ichthyological holdings in North American museums and had plotted the distributions of many Atlantic slope species. It wasn't long before I realized that such maps would in themselves be valuable contributions to the ichthyological literature. Thus, my horizons shortly expanded and I began seeking and maintaining distributional records for numerous North American freshwater fishes.

The history of the Atlas project will be summarized later in this Introduction, but its humble and naive beginnings were an outgrowth of that earlier, limited goal involving Maryland and Delaware fish locality records. As the project developed, I informally asked various ichthyologists for aid and direction and received several strong commitments from individuals who subsequently became atlas coauthors. During the social hour of the 1977 meetings of the Association of South-eastern Biologists in Raleigh I wrote on the back of a brown paper bag and gave to Carter Gilbert an abstract of the proposed project to be presented at the 1977 national meetings of the American Society of Ichthyologists and Herpetologists. The idea thus was committed. Through the efforts of state and federal agencies, and with the support and encouragement of numerous professionals, the proposal spawned what appears in this volume.

Once authorship was established and funding mechanisms seemed feasible, the authors held several meetings to plan the exact format of the atlas. None of us fully agreed on anything, and the result was a series of compromises between the ideal and the realistic. We tried to provide a format with both flexibility and consistency and one that would be useful on many discipline levels. Time constraints were real. It was obvious from the start that some compilers had the time and inclination to do more thorough work than others, and that the present information banks for individual species ranged from "nothing known" to species on which volumes had been published.

This project was an informative growth process for all who worked on it. During the last three to four years we have learned a lot about ichthyology and ichthyologists. Unfortunately, not all the biological facts that we gleaned would fit into our telegraphic format, and occasionally we were disappointed that we could not include extra tidbits in the accounts. How many knew that white sturgeons are known to eat onions and house cats?

To all those researchers who helped with this endeavor I would like to express my very deep gratitude. Not only would this atlas be of little merit without their work, but the project would never have been started without their prior commitments of support. Their combined efforts will give future students a foundation on which to build, a base that was not available when we had to determine, for example, which species of sculpins could be expected to occur in Maryland, with little knowledge of what was known from adjoining states.

A Brief History of the Project

While I was soliciting guidance in this project as it grew from the unsure beginnings outlined above, James A. McCann was trying to find someone to compile a report that would include range maps for all freshwater fishes in the United States. His interest in documenting these native ranges was to provide a basis for assessing potential and actual effects of introduced species on our fauna. The work was to supplement other activities proposed for the U. S. Fish and Wildlife Service's newly established National Fishery Research Laboratory in Gainesville, Florida, directed by McCann. It did not take long for the two proposed projects to discover each others needs and interests.

At the plenary session of the 1977 ASIH meetings, I presented the idea of a North American Freshwater Fish Atlas to the members in attendance. A format was proposed and suggestions for improvement encouraged. During the several days of the meeting, most of the authors and many of the compilers were marshalled. A few months later, after a tentative commitment of some funding from the U. S. Fish and Wildlife Service, the authors met in Raleigh to decide format guidelines, determine what species would and would not be included, establish review procedures, and suggest compilers for accounts.

Since that meeting we have made many minor adjustments to our format, record filing system, and review procedures; basically, however, the last three or so years were spent working toward completion of this first version of the atlas. Carter Gilbert and I each made extended trips to obtain museum records and to capture specimens for illustrations. Don McAllister expended considerable effort in locating many previously unpublished Canadian records. Jim McCann, besides working with us on maintaining funding at an adequate level, served as liaison with other federal, state, private, and professional groups, including the Sport Fishing Institute. The latter group provided partial funding to pay for costs of illustrations and their reduction and halftoning. Through it all I kept the many participants informed of progress with a series of newsletters.

Because of our regional review system, we thought it unnecessary to assure that primary authors represented all sections of the continent. In fact, the involvement of mostly east coast researchers was deemed necessary for several reasons. Not only did it enable us to hold meetings with minimal expenditures of time and money, but many of the unresolved distributional problems were in the east where the fauna is far richer and there is a scarcity of published regional texts with distributional maps.

As originally conceived, the species maps for the atlas were to mostly be the blackout type, with limits depicted as accurately as possible. Species previously dot mapped in other publications would, of course, have atlas maps showing "specific" localities. Our contract with the Fish and Wildlife Service stipulated dot maps for all species, and several authors flatly stated that if they were to participate we would have to include dot maps for most species. Despite a lack of records for fishes in certain states and drainage systems, we decided that most maps would be the dot type. That decision has been criticized in several important

quarters. One prominent researcher refused to aid the project because of it, and another, who did participate, subsequently voiced reservations. Nevertheless, the overwhelming consensus was (and still is) that carefully constructed dot maps provide information of both a level and detail not possible with blackout, shaded, or outline maps.

Species Coverage

Approximately 775 distribution maps and accounts of North American freshwater fishes are provided in the following pages. This includes 32 exotic species now successfully reproducing in North American waters, and a half a dozen extinct species. Mexico is excluded from the area of coverage, although the Mexican parts of the ranges of some "United States" species are mapped. Mexican fishes were omitted because (1) their inclusion would have added considerably to the preparation time of this volume; (2) their taxonomies and distributions are less extensively documented than those of the United States and Canada; and (3) Robert Rush Miller, University of Michigan, has for some time been involved in a detailed study of Mexican fishes.

Maps and accounts are provided only for full species, although maps or text for some species may distinguish ranges of subspecies. For the most part we included only named forms recognized in the American Fisheries Society checklist (Bailey et al. 1970, as tentatively updated by the 1980 AFS committee). We added, however, species and information contained in taxonomic revisions and descriptions that appeared in recognized journals since publication of the checklist. We accepted postchecklist name changes that have not been refuted in the literature. To obviate possible controversies, we communicated with C. Richard Robins, University of Miami, current chairman of the AFS checklist committee, for information on projected rulings. We hope that any inadvertent discrepancies between this atlas and the next edition of the AFS checklist will be minimal. This does not imply that authors of the atlas are in total agreement with validity of the species and names presented here. We simply chose not to make judgments in this forum. If additions and changes do not stand the test of time, the problem is readily solvable by virtue of the looseleaf format of the atlas.

Approximately 100 of the species herein covered are not freshwater fishes in the strict sense, since the atlas also includes anadromous and catadromous species, as well as marine and estuarine forms known to occur in fresh water. Although it was necessary to exercise our discretion in developing guidelines for the atlas, the basic goal was to provide maps and accounts for all officially recognized species likely to be encountered in North American freshwater habitats (even marginal ones), except those confined to Mexico.

Exotic species were included only if evidence exists that their populations are well established. Species are identified as extinct in only those cases where the weight of evidence is inescapable; additional species are believed extinct, but conclusive proof has not appeared. Those *species* officially considered endangered in the federal lists (*Federal Register* 45 (99) :33778, 20 May 1980) and *Gambusia georgei* (listed July 1980) are so noted herein, but threatened and endangered Canadian species are not.

Format

The following information is provided for each species: (1) order and family; (2) scientific and standard common name; (3) distribution map; and (4) brief.

essentially telegraphic statements summarizing current knowledge of or indicating sources for information concerning (a) type locality, (b) systematics, (c) distribution and habitat, (d) adult size, and (e) general biology.

ORDER AND FAMILY.--Classes, orders, and families are arranged phylogenetically (primitive groups through more advanced groups) in this volume. Because of space limitations, the classes of recent "fishes"--Agnatha (jawless fishes), pages 15-35; Chondrichthyes (cartilaginous fishes), pages 36-37; and Osteichthyes (bony fishes), pages 38-831--are not indicated in each account. This should present few problems. Inclusion of order and family will allow users not already familiar with classification of fishes to recognize major natural groupings and relationships. For greater utility, within a family the genera and species are arranged alphabetically. This arrangement follows that of the American Fisheries Society checklist. It is not just an arrangement of convenience; in many cases the knowledge of taxonomic relationships within families is so fragmentary that arrangements based on phylogeny would be premature.

NAMES.--The scientific name (*Genus* and *species*) is followed by the last name of the author or authors of the species. An author's name in parentheses indicates that the species is currently recognized in a genus other than that in which it was originally described. The standard common name of each species appears below its scientific name. Although for purposes of style the first letter in the common name is capitalized in each account, it should be noted that for normal usage most authors and editors now prefer the entire common name in lower case (except for proper nouns). For additional guidelines concerning common names and nomenclature see the American Fisheries Society checklist (Bailey et al. 1970), and the Council of Biology Editors style manual (CBE Style Manual Committee. 1978).

TYPE LOCALITY.--The collection site for the holotype or syntypic specimens on which the description of the species was based is given where known. This is followed by the literature citation for the original description. Where date of publication on the cover of the journal or publication in which the description appeared differs from the date on which the journal actually was printed or mailed, the cover date appears in brackets. In some cases the type locality was not originally designated, or was so ambiguous that it was later restricted. Literature documentation of this is provided as needed.

SYSTEMATICS.--The section on systematics is intended to provide some understanding of the species' relationship to other fishes, and to direct the reader to taxonomic treatments of variation and relationships if such studies exist or to unresolved taxonomic problems. We provided information on synonymies only where such clarification seemed warranted. Subgeneric allocations are usually given, often followed by a brief discussion of the species' position within the subgenus. For monotypic species and certain fish groups we included additional information as knowledge and space allowed. Primary information sources for such items are normally provided. Since exotic fishes may present major identification problems, sources of keys to most species are provided in this section.

ILLUSTRATIONS.--The illustrations are from a wide variety of sources (credits are listed elsewhere) and vary considerably in quality. In many cases quality was further lost in the reproduction/reduction process. Where such information was available a brief caption provides locality, size, and an abbreviated credit line for the illustration source. The sex of the individual usually is

provided if known, and for most species only adults are illustrated. Many illustrations were not reviewed. The credit line for the illustration is for its source and does not necessarily reflect where the actual specimen is housed.

MAPS.--Dot maps are usually provided, with each dot representing a specific locality of capture. Information on each record is filed at the North Carolina State Museum and/or with the compiler. Localities are based on dot maps, previously published reliable literature records, specimens examined, and museum records that we believed to be accurate. Much time and effort was spent confirming peripheral and other suspect records. For some species dot maps were not practical, and blackout maps indicate the general documented range of these. If the map is from a previously published source, credit is given; previously published but updated maps bear a "map modified from ..." statement. Multiple symbols are explained, but additional information often appears in the text under "Distribution and Habitat." Where the area illustrated is so limited that readers may have difficulty orienting the map, and in most instances where the species also occurs outside the area mapped, we included insets. Compilers sometimes chose to map several species together to show zoogeographic relationships.

Latitude and longitude indicators and map scales were not included on most accounts. This saved time and eliminated potential errors during map preparation.

The map format was mostly left to the discretion of the compiler, and flexibility in use of base maps, dot size, and similar matters generally allowed for the best distribution documentation possible in the space provided. For many maps, however, dot size is not ideal. This was a result not only of variation in compiler preference but of differential reduction of maps. We plan to remedy this as accounts and maps are updated.

DISTRIBUTION AND HABITAT.--Because this section was consistently longer than other sections of accounts, we normally did not cite sources. For most wideranging forms, too many citations would have been necessary. For species with restricted ranges, citations usually would have been duplicative of those found elsewhere in the account. General summaries of the species' distribution and preferred habitat are provided, and most accounts include a statement of relative abundance.

ADULT SIZE.--We attempted to indicate typical adult size for each species. Several problems, perhaps not apparent to persons unfamiliar with recent ichthyological literature, arose. (1) Minimum adult (i.e., reproductive) size is not known for most species, and for many there is no published information on typical adult size. (2) There is great interpopulation variation in size, and occasionally significant size variation in the sexes, of the same species. Dwarf populations of some species are known, and for wide ranging forms size often varies considerably with latitude. (3) Fish continue to grow throughout their lives, thus exceptionally large individuals that greatly exceed what is generally considered normal size occasionally are encountered for many species. These maximum records often were the only published size information (Guinness logic). Nevertheless, since "normal" size is subject to so much more variation, maximum size may perhaps be the best indicator. (4) For some species we do not know spawning season or habitat, so obtaining a series of breeding specimens to determine variation in adult size was not feasible. (5) Even where published information was available, measuring techniques were not always consistent. Length may appear as total length (TL), standard length (SL), or fork length (FL).

Despite these problems, in most cases we were able to provide a typical size range for adults. Length data usually were compiled from several published

sources, and on those occasions where compilers were unable to locate reliable information they provided data from personal study. Maximum sizes, at least lengths of exceptionally large individuals, also are provided if they greatly exceed the typical range. A statement of maximum size does not indicate that all sources were checked for record specimens. Approximations are prefaced with ca. (circa = about). Where options were available, length is expressed in SL, and TL was preferred over FL. All length and weight measurements were converted to metric. Our goal was to give the best possible impression of adult size using the sources available. We expect to refine length measurements for many species in future editions of the atlas. Including this information provided one of our greatest problems, and most size ranges should not be considered definitive.

Our space/format budget made it impractical to indicate the sources of adult size information. Size was generally determined from information in works cited in the account, from the compilers' personal records, or from sources such as Carlander (1969-1977, *Handbook of Freshwater Fishery Biology* Vols. 1 & 2), Scott and Crossman (1973, *Freshwater Fishes of Canada*) and other works that surveyed a wide cross-section of literature.

BIOLOGY.--In most accounts the reader is directed to specific studies containing biological information. Earlier summaries were omitted if more recent ones were available. Some compilers elected to provide a few important details, while others, usually because of space limitations, provided only references. No published information was available for many species, but for others the literature was so extensive that we had to limit discussion to only primary sources. If considerable information was available we let the compiler decide what to include. For many species biological data are original.

COMPILERS.--Many maps and accounts were prepared or reviewed by primary authorities on particular species or species groups. Accounts and maps of other species were compiled "in house" by the primary authors of the atlas or by support staff connected with their respective institutions. Some compilers volunteered on a regional basis, preparing maps and accounts for many species in their areas. Some volunteer compilers, although lacking particular expertise with the species, prepared accounts that had remained unassigned or for which there were no living ichthyologists with extensive experience. Date of completion of the account follows the compiler's name; most information published after this date is not included in the account. However, new distributional records were added until approximately December 1979 if their addition did not require extensive changes in the text. Approximately 115 compilers participated in the first edition of the atlas.

ABBREVIATIONS AND LITERATURE CITATIONS.--In trying to include as much information as possible in each account, we found it desirable to use many abbreviations. On the other hand, we sometimes arbitrarily chose, either consistently throughout the book or in individual accounts, to spell out certain words that commonly are abbreviated. We hope this tactic has enabled us to provide maximum information in each account without reducing the text to "alphabet soup." The majority of abbreviations are standard. Abbreviations of literature citations for the most part follow the 1977 *Biosis List of Serials* (Bio-Sciences Information Service, 2100 Arch Street, Philadelphia, PA 19103 USA). For journal articles we included complete references, excluding titles. This decision was based on the premise that such information may be needed for interlibrary loans of specific articles. Books frequently mentioned are cited by author, date and title, with complete citations appearing in **Appendix A (837-848)**.

Compass directions are expressed in lower case (n, e, s, w), or spelled out as needed to limit confusion with state and province abbreviations, which are capitalized. State and province abbreviations are mostly standard postal ones and follow those given by Carlander (1969, *Handbook of Freshwater Fishery Biology* Vol. 1). They are:

United States

Alabama	AL	Kentucky	KY	Ohio	OH
Alaska	AK	Louisiana	LA	Oklahoma	OK
Arizona	AZ	Maine	ME	Oregon	OR
Arkansas	AR	Maryland	MD	Pennsylvania	PA
California	CA	Massachusetts	MA	Rhode Island	RI
Colorado	CO	Michigan	MI	South Carolina	SC
Connecticut	CT	Minnesota	MN	South Dakota	SD
Delaware	DE	Mississippi	MS	Tennessee	TN
District of Columbia	DC	Missouri	MO	Texas	TX
Florida	FL	Montana	MT	Utah	UT
Georgia	GA	Nebraska	NB	Vermont	VT
Idaho	ID	Nevada	NV	Virginia	VA
Illinois	IL	New Hampshire	NH	Washington	WA
Indiana	IN	New Jersey	NJ	West Virginia	WV
Iowa	IA	New Mexico	NM	Wisconsin	WI
Kansas	KS	New York	NY	Wyoming	WY
		North Carolina	NC		
		North Dakota	ND		

Canadian Provinces and Territories

Alberta	AT	Newfoundland	NF	Prince Edward	
British Columbia	BC	Northwest		Island	PE
		Territories	NT	Quebec	QU
Manitoba	MB	Nova Scotia	NS	Saskatchewan	SA
New Brunswick	NK	Ontario	ON	Yukon Territory	YU

Sizes are expressed in metric units as SL (standard length), TL (total length), FL (fork length), or DW (disk width). For a description of how these measurements are taken, see the appropriate section under "Definitions."

Most other abbreviations are those of institutions, agencies, or organizations as follows: ASIH, American Society of Ichthyologists and Herpetologists; FAU, Florida Atlantic University; FSM, Florida State Museum; INHS, Illinois Natural History Survey; NMC, National Museums of Canada; NCSM, North Carolina State Museum; ROM, Royal Ontario Museum; SIO, Scripps Institution of Oceanography; UAIC, University of Alabama Ichthyological Collections; UNCW, University of North Carolina-Wilmington; UMMZ, University of Michigan Museum of Zoology; UNLV, University of Nevada-Las Vegas; USFWS, United States Fish and Wildlife Service; USNM, United States National Museum of Natural History; and UT, University of Tennessee.

SOURCES OF DISTRIBUTIONAL RECORDS.--In addition to state and regional publications, the plotted distributional records came from a variety of sources. Records for most fishes with limited distributions came from appropriate regional literature, examined museum specimens, and published papers dealing with each species. For wide ranging forms a combination of literature records,

museum specimen records, and contributions of regional reviewers were used. In the "Acknowledgments" section is a list of those museums that either provided records of their holdings, or allowed us to examine specimens specifically for purposes of the atlas, or both. Many records came from working data of reviewers. Records that came to our attention after maps were submitted were normally added, and compilers were informed of such changes. We provided compilers and reviewers with sources for questionable records, most of which were brought to our attention by reviewers. If records remained questionable, they either were so identified or deleted from maps.

REVIEW SYSTEMS.--Since accounts were prepared by many different compilers, we decided to have each account and map reviewed as thoroughly as possible. This was particularly desirable for those compiled by workers other than authorities on particular species. Every account and map was reviewed by each of the primary authors, then further reviewed as necessary by other authorities. Most maps and accounts of wideranging species were sent to appropriate regional reviewers as well. As reviews returned, we revised each account to meet suggestions of reviewers and to see that each conformed to the somewhat flexible format of the atlas. This, of course, made necessary some seemingly arbitrary editorial judgments, and we occasionally had to further correspond with initial compilers. John E. Cooper then read each account prior to typesetting to guard against such gems of phrasing as "common where found" and "completely extinct."

Compilers were provided with galleys, and photoready pasteups were made from corrected proofs. Copies of these went to all primary authors, appropriate compilers, the U. S. Fish and Wildlife Service's Fishery Research Laboratory in Gainesville, and, if necessary, to regional reviewers for consideration of distributional gaps and other problems. Throughout this process, compilers and primary authors were conducting additional correspondence in their attempts to organize fragmentary records. This review procedure should have produced relatively flawless accounts, but we were amazed at the number of overlooked errors that persisted. Some resulted from our attempts to correct or refine accounts. We were finally forced to conclude that there is no such thing as a perfect review system, that we were incapable of total consistency, and that there are many errors which remain overlooked! We sincerely hope that these will be brought to our attention.

PRODUCTION PROCESS.--Each account was commercially typeset and printed, but corrections and changes were pasted in by our technicians. The layouts of "final" photoready copy, illustrations, and maps were done inhouse. Since most type was set on computer type presses, a number of interesting hyphenations and spacings of words and numbers resulted. We corrected those that were particularly obvious and offensive, but others were either left in the interest of expediency or were simply overlooked. Several different shops were involved in typesetting, so there is some inconsistency in typefaces.

Maps arrived in a variety of forms and conditions. Many were excellent and needed only to be reduced to fit space remaining after the text was set. Others had to be plotted or replotted for one reason or another; some were photocopies of previously published but outdated maps, and a few compilers sent only a list of localities.

Most pen and ink illustrations reduced and reproduced well. Pencil drawings reproduced less well, and illustrations made from photographs are quite variable in quality. Many seemingly excellent photos reproduced poorly, a result of reduction, negative or positive flipping, and halftoning. Light photos became grey, grey ones dark, and dark ones black. Black and white negatives made from slides generally proved unsatisfactory.

To reduce initial production costs, nearly all reduction work on maps and photos and all halftoning were done inhouse. Results were generally satisfactory but we occasionally obtained less than perfect exposures despite numerous efforts to rephotograph particular maps or illustrations. While we recognize the shortcomings of these efforts, compromise was necessary to make timely completion of a relatively inexpensive first edition a realistic goal.

FUTURE EDITIONS.--We plan to update individual accounts as needs arise. Accounts and maps in which there are major errors will be given first priority, and new information will be incorporated into other accounts as feasible. Newly revised species groups will be given second priority. We anticipate preparing 20 to 30 revised accounts per year. New illustrations and maps will be made where warranted. Revised accounts will be distributed to interested persons on an "at cost" basis; details will be announced in appropriate journals. We plan to eventually revise a majority of accounts and maps and prepare a new edition of the atlas. Luis Rivas and Richard Franz, who have both been studying Greater Antillean freshwater fishes, have about 50 accounts of these species near completion, and these will be available in the near future.

We assume that within a decade or less, field guides, some other text, or an effort similar to the *Catalogue of American Amphibians and Reptiles* will make this volume obsolete. Meanwhile, the N.C. State Museum intends, as time, person-power and space allows, to maintain additional information as it becomes available. We hope that researchers acquiring significant new information will publish it in appropriate journals. More trivial data could be sent to the compilers of specific accounts or to the N.C. State Museum to assure its inclusion in future atlas revisions, or at least its availability to future students. All atlas authors as well as the N.C. State Museum and U.S. Fish and Wildlife Service regard this project as a service. Therefore, we will make every effort to provide assistance to persons or agencies requesting specific information on which accounts were based, or new information that later becomes available. Please remember, however, that none of us is a full-time employee for the atlas, and services can only be provided as time permits. In most cases specific compilers would be the most appropriate sources of information.

WORDS OF CAUTION.--This is a provisional effort to document the distributions of North American freshwater fishes, and to provide some additional information on each species. While some accounts are definitive, providing all known information on a species or including its most recent treatment, the majority are not. Experienced ichthyologists will have little trouble recognizing the shortcomings of this volume. Novices, however, may mistakenly assume that a work of this magnitude must surely be the final reference for all North American freshwater fishes. This is certainly not the case and was never our intended goal. Researchers are urged to refer to literature cited in accounts, and to contact compilers or primary authors regarding areas in question.

The atlas will be a useful tool to many endeavors, but we repeat that it is a preliminary effort. For some states we have few distributional records, which means that not much information exists, or that availability of records presented a problem. Some workers with extensive regional knowledge either did not have the time or the interest to assemble and provide data for the atlas. In a few other cases we simply were not aware of potential contributors who failed to see or did not respond to our repeated requests for assistance. Whatever the reasons, most maps of wideranging species are far from complete.

Some accounts and maps were prepared by primary authorities on those species or groups, others by their students. Most were at least reviewed by compe-

tent authorities. Numerous species, however, have never been studied in detail throughout their ranges. For others, there are no ichthyologists possessing adequate knowledge of distributions, or able and willing to contribute time to this project.

All things considered, we urge that journal and other editors make every effort to discourage authors from generally using the atlas as their principal source of information.

HOW TO CITE THIS VOLUME AND INDIVIDUAL ACCOUNTS.--The format of the atlas will provide perpetual headaches for authors and others needing to cite it in part. The entire work should be cited thusly:

Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister and J. R. Stauffer, Jr. 1980 et seq. *Atlas of North American Freshwater Fishes*. N. C. State Mus. Nat. Hist., Raleigh. i-x + 854 pp.

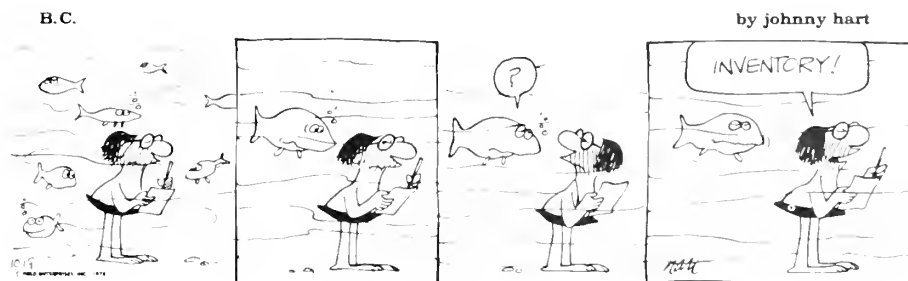
In citing individual accounts, show compiler, date, species, common name, page *in*, then cite the volume. Example:

Burr, B. M. 1980. *Polyodon spathula* (Walbaum), Paddlefish. pp. 45-46 *in* D. S. Lee, et al. *Atlas of North American Freshwater Fishes*. N. C. State Mus. Nat. Hist., Raleigh. i-x+854 pp.

Other combinations occasionally will be needed in citations, as where it is necessary to cite several species in one genus. The major point to keep in mind is that compilers should receive credit for their accounts. Authors should remember that it is more appropriate to cite primary literature sources than the atlas.

A FINAL NOTE.--While the support of the U. S. Fish and Wildlife Service, the Sport Fishing Institute, the N. C. State Museum, and volunteer compilers, and the hard work of my coauthors, all made this volume possible, many of the decisions concerning format and deadlines were exclusively mine. Time and distance factors did not provide opportunity for total collaboration. It should therefore be recognized that while credit for the accuracy of content belongs to combinations of all those acknowledged, any problems, errors, inconsistencies, and omissions are my responsibility and criticisms in these areas need not be shared.

Dave Lee
N. C. State Museum
April 1980



B. C. by permission of Johnny Hart and Field Enterprises, Inc.

Ichthyomyzon bdellium (Jordan)
Ohio lamprey

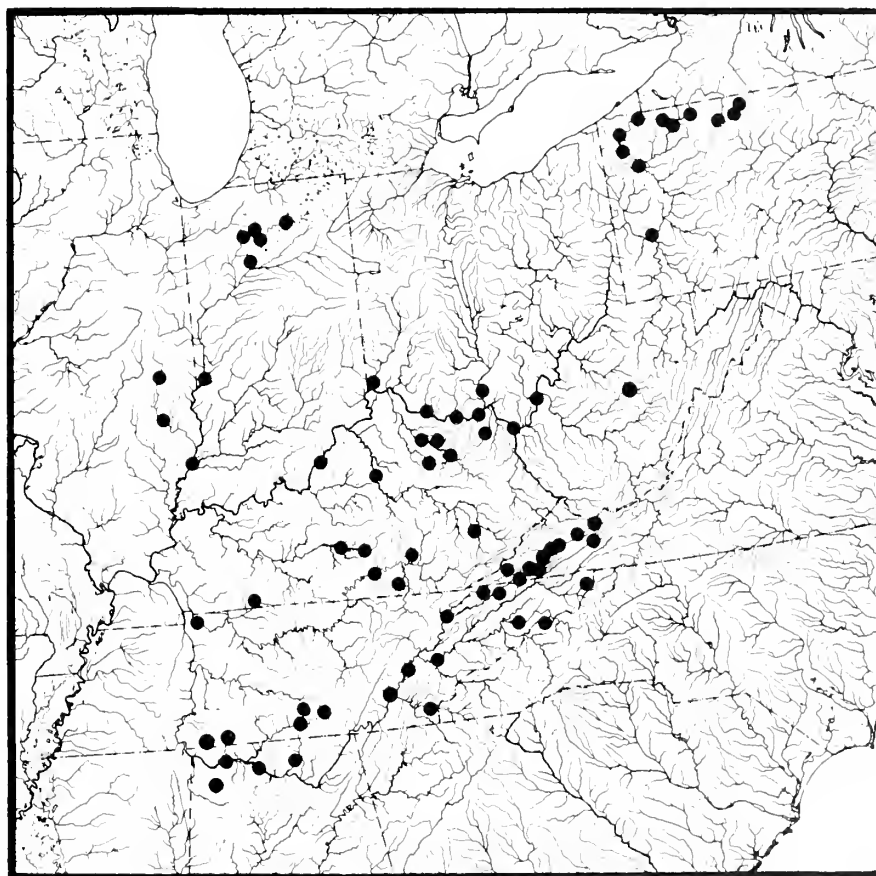
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Great Miami River, OH (Jordan 1885. Ann. Rept. U.S. Comm. Fish. and Fish.: 789-973).

SYSTEMATICS: Considered a derivative of *I. castaneus*. Gave rise to non-parasitic *I. greeleyi* and "*I. hubbsi*" (Hubbs and Potter in Hardisty and Potter 1971. *The Biology of Lampreys* Vol. 1).



WV: Kanawha Co., Kanawha River, 225 mm TL (NCSM).



DISTRIBUTION AND HABITAT: Throughout Ohio River basin, including Allegheny, Wabash, and Upper Tennessee drainages. Ammocoetes (larval stage) in creeks and small rivers, adults in medium-to large-sized rivers (Hubbs and Potter 1971). Uncommon.

ADULT SIZE: ca. 124-259 mm TL, 272 mm TL maximum.

BIOLOGY: Parasitic. Mellinger (1965. M. Ed. thesis, Pennsylvania State Univ.) reported on length-frequency distribution of ammocoetes. Nist (1967. M. Ed. thesis, Pennsylvania State Univ.) discussed growth and behavior of immature specimens. Apparently lives four years as an ammocoete and 23 months as an adult. Spawns at beginning of second summer of adult life, then dies.

Compilers: F. C. Rohde and J. Lanteigne-Courchene. January 1979.

Ichthyomyzon castaneus Girard
Chestnut lamprey

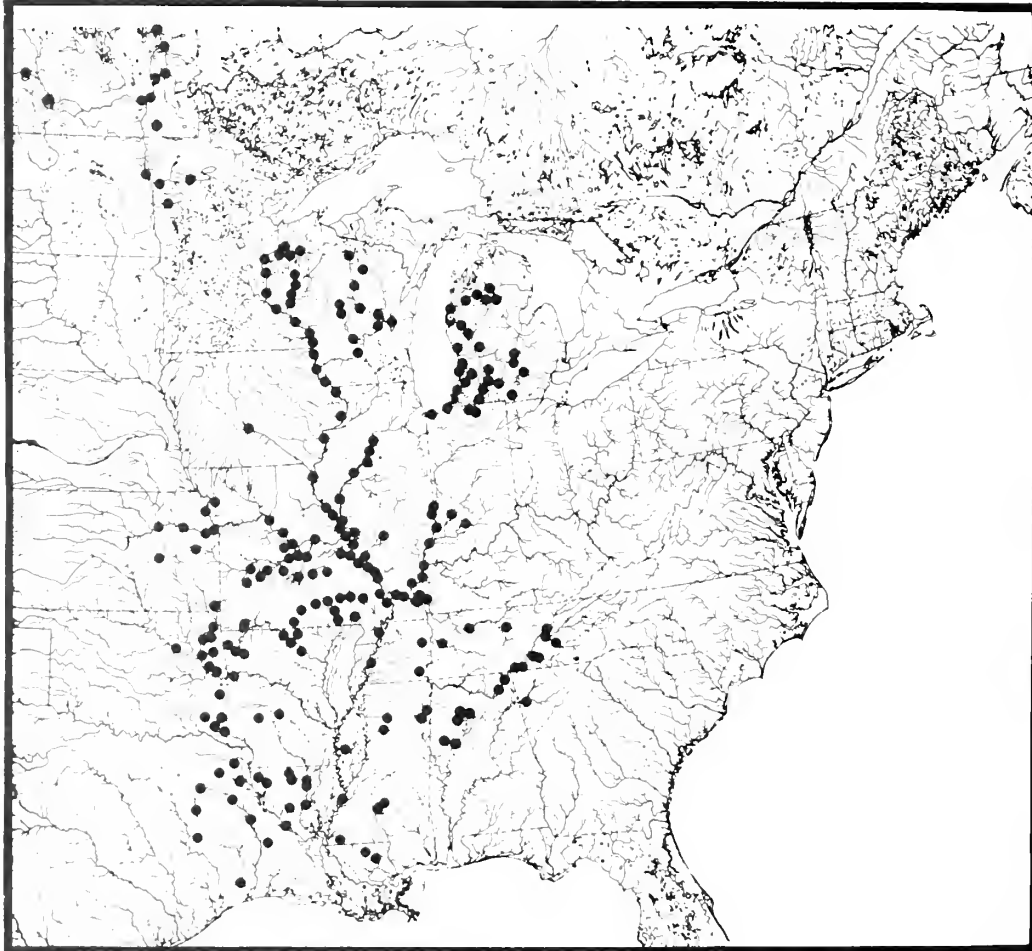
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Galena, MN (Girard 1858. U.S. Pac. R.R. Explor. Surv. 10:1-400).

SYSTEMATICS Hubbs and Trautman (1937. Misc. Publ. Mus. Zool. Univ. Mich. 35:1-109) reviewed this and other members of genus. Probably derived from *I. unicuspis* (Hubbs and Potter in Hardisty and Potter 1971. *The Biology of Lampreys* Vol. 1)



MO: Boone Co., Missouri
River, Rocheport (Mo. Dept.
Cons.).



DISTRIBUTION AND HABITAT: Red River of North, Mississippi River, Great Lakes, and Mobile Bay basins. Ranges southeast from west-central MB south to Great Lakes (Lake Michigan drainage) and Mississippi River basin from WI and MN south to LA. In main rivers of Mobile Bay basin from MS to GA, where now quite rare. Adults usually encountered in large reservoirs and rivers.

ADULT SIZE: ca. 105-305 mm TL, 310 mm TL maximum.

BIOLOGY: Parasitic. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), Pflieger (1975. *The Fishes of Missouri*), and Scott and Crossman (1973. *Freshwater Fishes of Canada*) summarized life history data and biological information. Adults reported to live 18 months in MI, but to feed actively for only five months (Hall 1962. Abstr. Am. Fish. Soc. 92). A 284 mm female from OK reported to contain about 42,000 eggs (Hall and Moore 1954. Copeia: 127-35).

Compilers: F. C. Rohde and J. Lanteigne-Courchene. April 1978.

Ichthyomyzon fossor Reighard and
Cummins
Northern brook lamprey

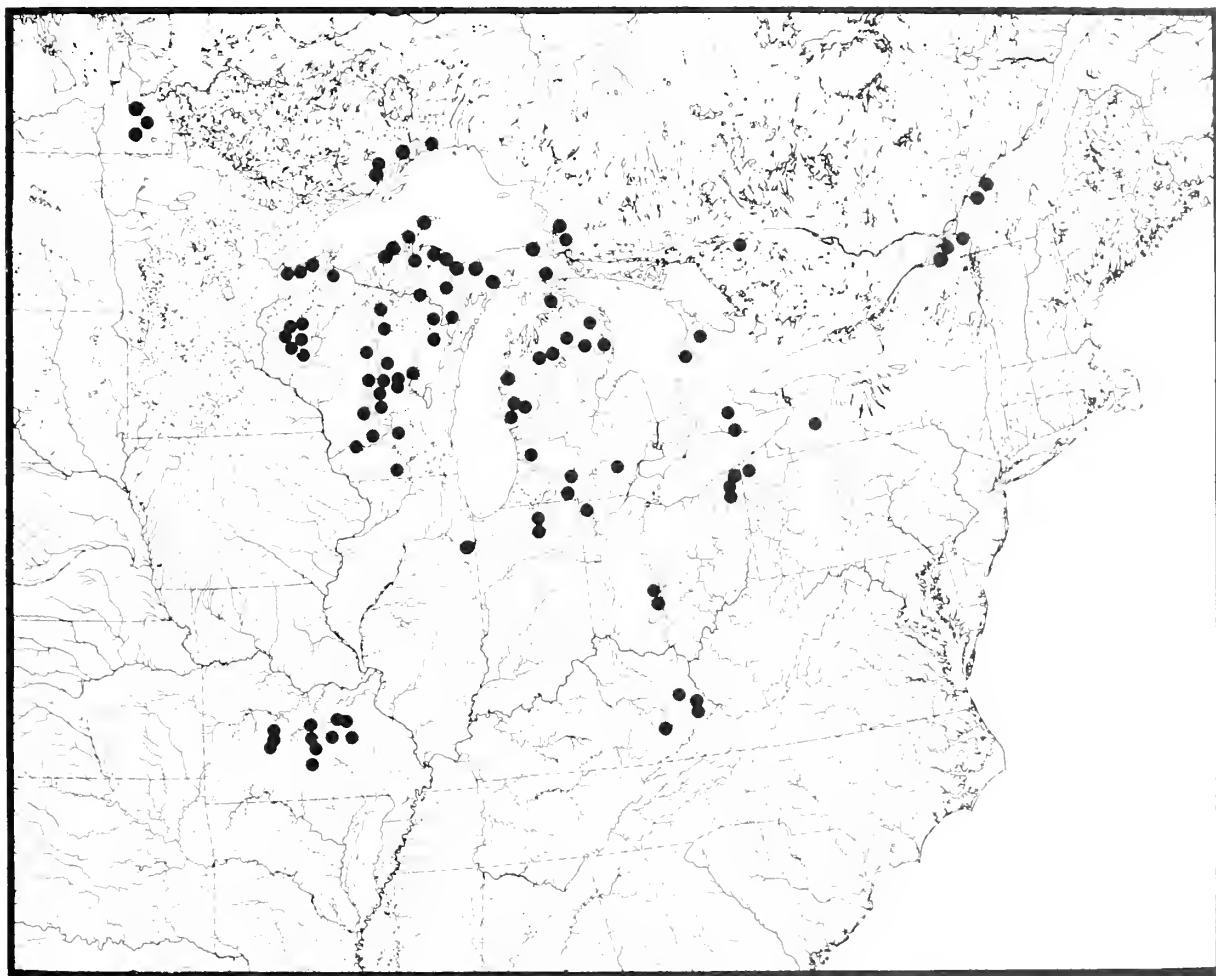
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Mill Creek, tributary to Huron River (Lake Erie drainage), Washtenaw Co., MI (Reighard and Cummins 1916. Occas. Pap. Mus. Zool. Univ. Mich. 31:1-12).

SYSTEMATICS: Nonparasitic derivative of *I. unicuspis* (Hubbs and Potter in Hardisty and Potter 1971. *The Biology of Lampreys*).



(NCSM)



DISTRIBUTION AND HABITAT: Ranges from MB and QU south to IN, KY, and MO; southern populations relatively isolated. In medium-sized streams. Adults taken over gravel, ammocoetes in beds of silt, sand, and organic debris (Pflieger 1975. *The Fishes of Missouri*).

ADULT SIZE: ca. 109-150 mm TL, 163 mm TL maximum.

BIOLOGY: Nonparasitic. Life history in MI described by Okkelberg (1922. Occas. Pap. Mus. Zool. Univ. Mich. 125:1-14). Hubbs (1924. Pap. Mich. Acad. Sci. Arts Lett. 4:587-603) and Purvis (1970. Copeia:326-32); in IN by Leach (1940. Copeia:21-34); and in WI by Churchill (1947. Trans. Wis. Acad. Sci. Arts Lett. 37:337-46).
Compilers : F.C. Rohde and J. Lanteigne-Courchene. February 1978.

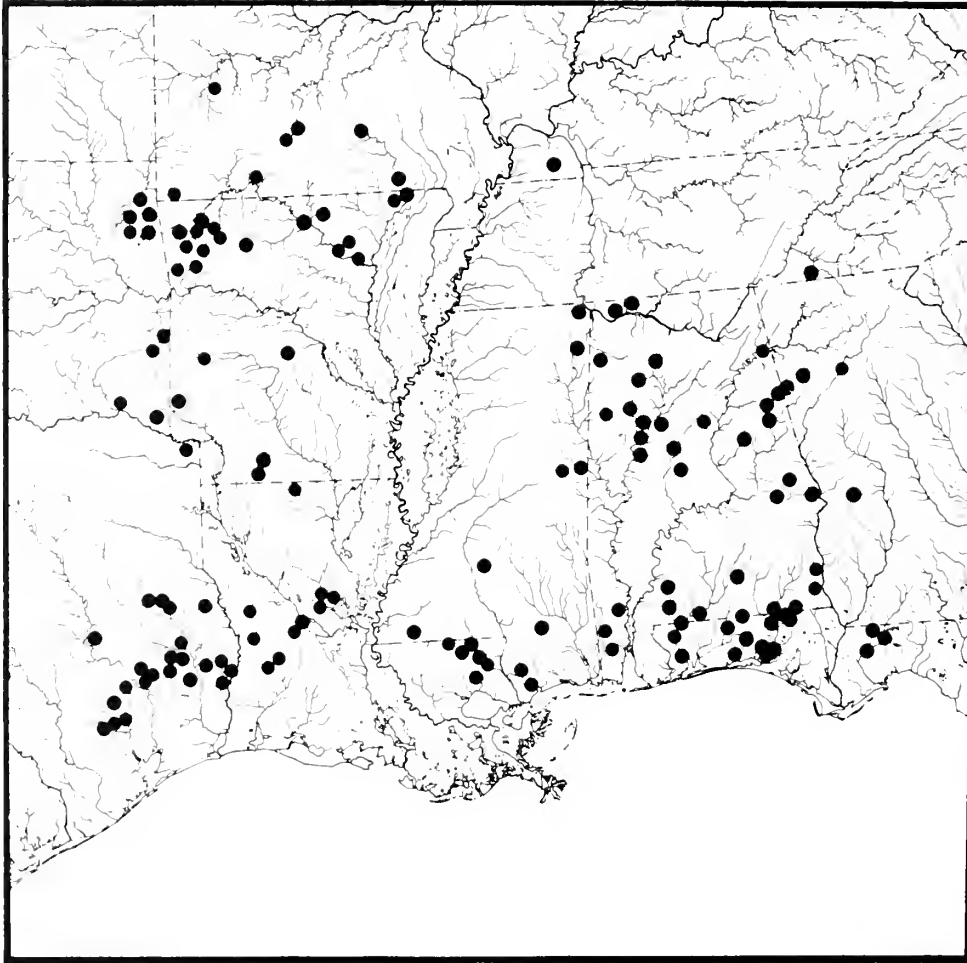
Ichthyomyzon gagei Hubbs and
Trautman
Southern brook lamprey

Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Stream 0.8 km s of Dry Prong, Grant Par., LA (Hubbs and Trautman 1937. Misc. Publ. Mus. Zool. Univ. Mich. 35:1-109).

SYSTEMATICS: Derived from *I. castaneus* (Hubbs and Potter in Hardisty and Potter [eds.] 1971. *The Biology of Lampreys* Vol. 1). Hubbs and Trautman (1937) reviewed *Ichthyomyzon*, and Hubbs and Potter (in Hardisty and Potter [eds.] 1971) listed species and indicated relationships and derivations.

GA: Gilmer Co., Cartecay River,
132 mm TL (NCSM).



DISTRIBUTION AND HABITAT: Gulf of Mexico drainage from OK and TX north to MO and east to FL, GA, and TN. Adults found in medium-sized streams. Ammocoetes found in areas of slack, marginal water in the same stream. Not uncommon, but, as is true of all nonparasitic lampreys, adults are found only during spring spawning months.

ADULT SIZE: ca. 80-159 mm TL, 166 mm TL maximum.

BIOLOGY: Nonparasitic species. Dendy and Scott (1953. *Copeia*:152-62) discussed spawning habits, fecundity, and early ammocoete development. Moshin and Gallaway (1977. *Southwest. Nat.* 22:107-14) discussed seasonal abundance, food habits, and condition. Spawns from March to May. Ammocoetes require at least three years to complete development. Diet consists primarily of diatoms.

Compilers: F. C. Rohde and J. Lantaigne-Courchene. May 1978.

Ichthyomyzon greeleyi Hubbs
and Trautman
Allegheny brook lamprey

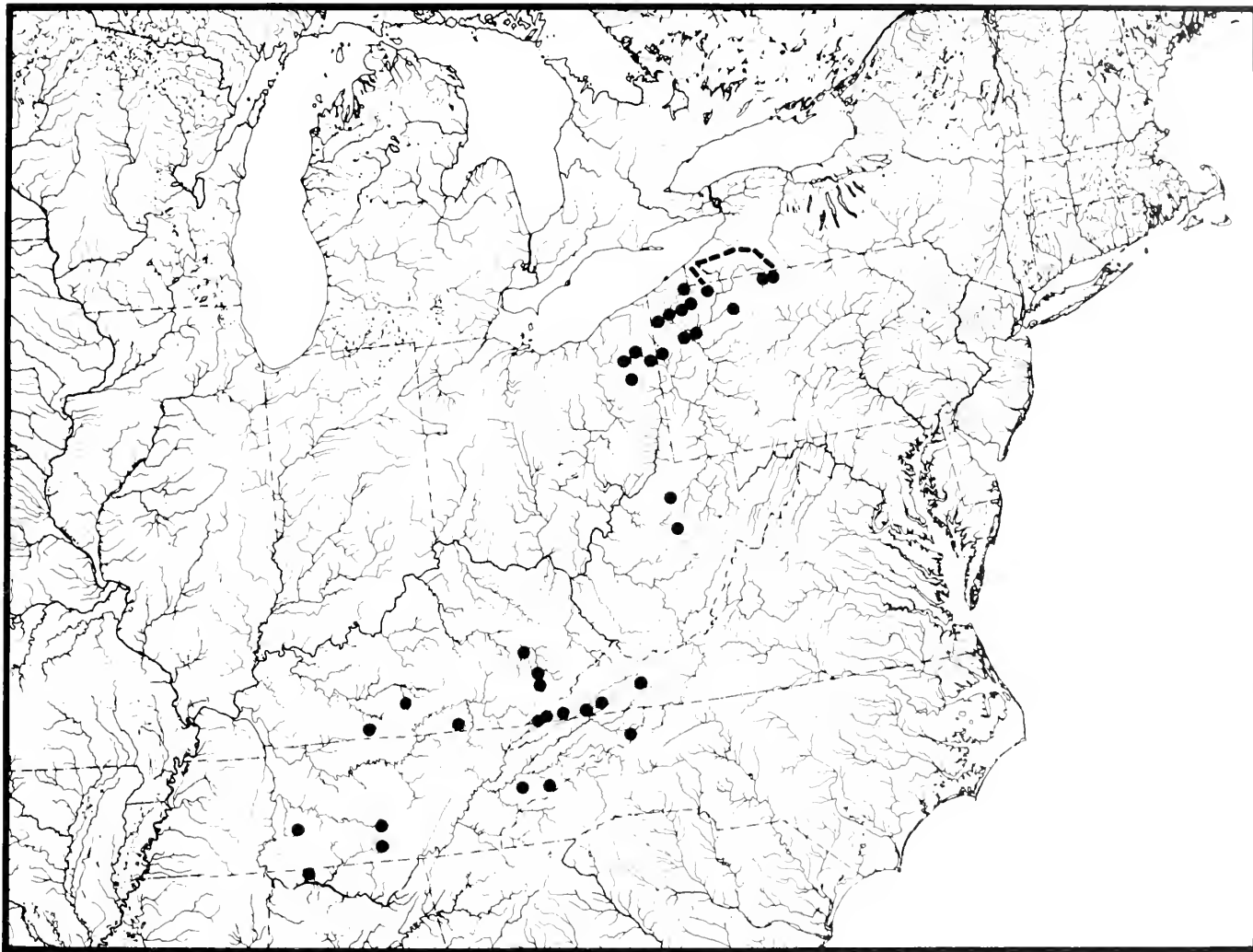
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: French Creek, tributary to Allegheny River, 1.6 km e of Wattsburg, Erie Co., PA (Hubbs and Trautman 1937. Misc. Publ. Mus. Zool. Univ. Mich. 35:1-109).

SYSTEMATICS: Derived from *I. bdellium* (Hubbs and Potter in Hardisty and Potter 1971. *The Biology of Lampreys* Vol. 1).



TN: Johnson Co., Holston River system, 45 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Tributaries of Ohio River drainage in NY, PA, OH, WV, and KY. Not common except perhaps in northwest PA. Spends its life in creeks.

ADULT SIZE: ca. 110-150 mm TL, 172 mm TL maximum.

BIOLOGY: Nonparasitic. Raney (1939. Copeia:111-12) observed breeding in PA during May. Spawning was most intense in mid-afternoon and occurred in middle and lower portions of riffles. Schwartz (1959. Ohio J. Sci. 59:217-20) commented on its and *Lamprolaima aepyptera*'s occurrence in WV, where they occupy different regions of the Little Kanawha River.

Compilers: F. C. Rohde and J. Lanteigne-Courchene. February 1978.

Ichthyomyzon unicuspis Hubbs and
Trautman
Silver lamprey

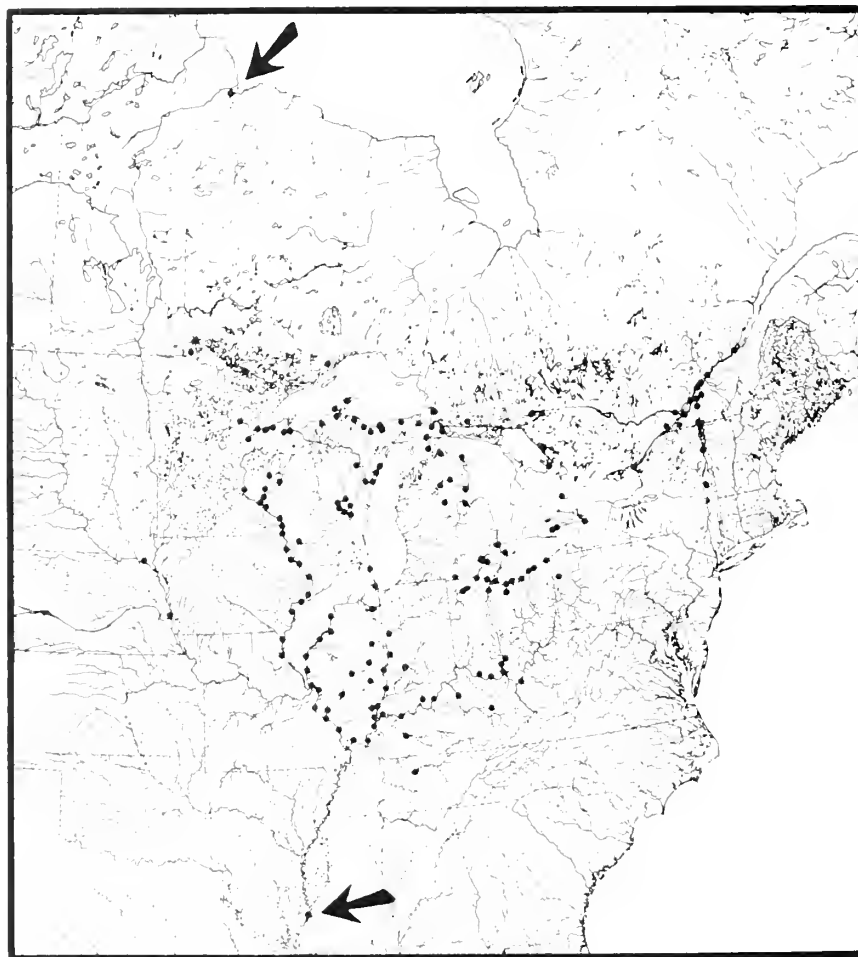
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Swan Creek, 4.8 km above confluence with lower Maumee River, Toledo, Lucas Co., OH (Hubbs and Trautman 1937, Misc. Publ. Mus. Zool. Univ. Mich. 35:53-65).

SYSTEMATICS: Most primitive species of *Ichthyomyzon* (Hubbs and Potter in Hardisty and Potter 1971, *The Biology of Lampreys* Vol. 1). Hubbs and Trautman (1937) revised genus.



253 mm TL (W. W. Hunt).



DISTRIBUTION AND HABITAT: Hudson Bay, Great Lakes, and St. Lawrence River drainages and in Mississippi basin from MN and WI south to TN. Isolated record from Mississippi River in MS. Adults in rivers and lakes feeding on fishes. Adults migrate upstream to spawn over sand and gravel riffles of moderate-sided streams. Ammocoetes in sand and mud areas. Not commonly encountered except during spawning.

ADULT SIZE: ca. 89-312 mm TL, 370 mm TL maximum.

BIOLOGY: Parasitic. Adults spawn in the spring. Egg number averages 10,800. Ammocoete stage lasts from four to seven years. Feeds on microscopic plants and animals, such as algae, pollen, diatoms, and protozoans. Metamorphosis begins late fall, completed early spring, then downstream migration to lakes or large rivers occurs. Life span of adults from 10 to 20 months (Scott and Crossman 1973, *Freshwater Fishes of Canada*).

Compilers: F. C. Rohde and J. Lanteigne-Courchene

Lampetra aepyptera (Abbott)
Least brook lamprey

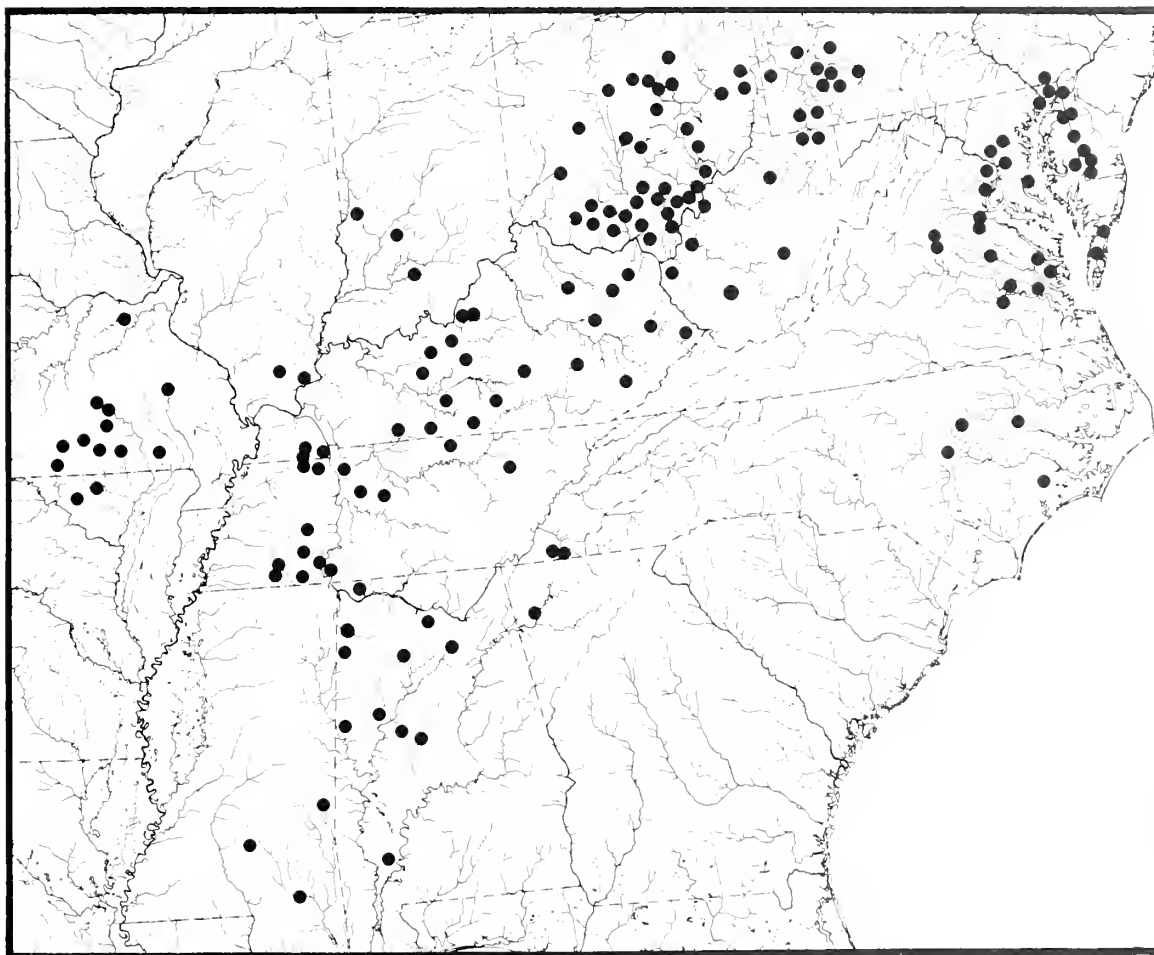
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Ohio River, near Portland, Meigs Co., OH (Abbott 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:325-28).

SYSTEMATICS: Subgenus *Okkelbergia*. Hubbs and Potter (*in* Hardisty and Potter [eds.] 1971. *The Biology of Lampreys* Vol. 1) regarded *Okkelbergia* as distinct, monotypic genus. This allocation questioned by Vladykov and Kott (1976. Can. J. Zool. 54:421-25). Closest relative is *L. meridionale*, which may not be specifically distinct.



MD: Cecil Co., Perch Creek,
111 mm TL (NCSM).



DISTRIBUTION AND HABITAT: On Atlantic slope from PA to NC; west of Appalachians from PA, AL, OH, and MS west to MO and AR. Restricted to creeks. Ammonoetes found in quiet waters with mud bottom. Adults usually taken while spawning over sand and gravel areas.

ADULT SIZE: ca. 91-151 mm TL, 180 mm TL maximum.

BIOLOGY: Nonparasitic. Definitive studies by Seversmith (1953. Copeia: 225-32) and Rohde et al. (1976. Bull. South. Calif. Acad. Sci. 75:99-111). Larval period usually 5.5 and in some cases 6.3 years. Transformation to adults begins in late summer and takes five to six weeks. Spawns mid to late March in DE.

Compilers: F. C. Rohde and R. E. Jenkins.
March 1980.

Lampetra alaskense (Vladykov and Kott)
Darktail lamprey

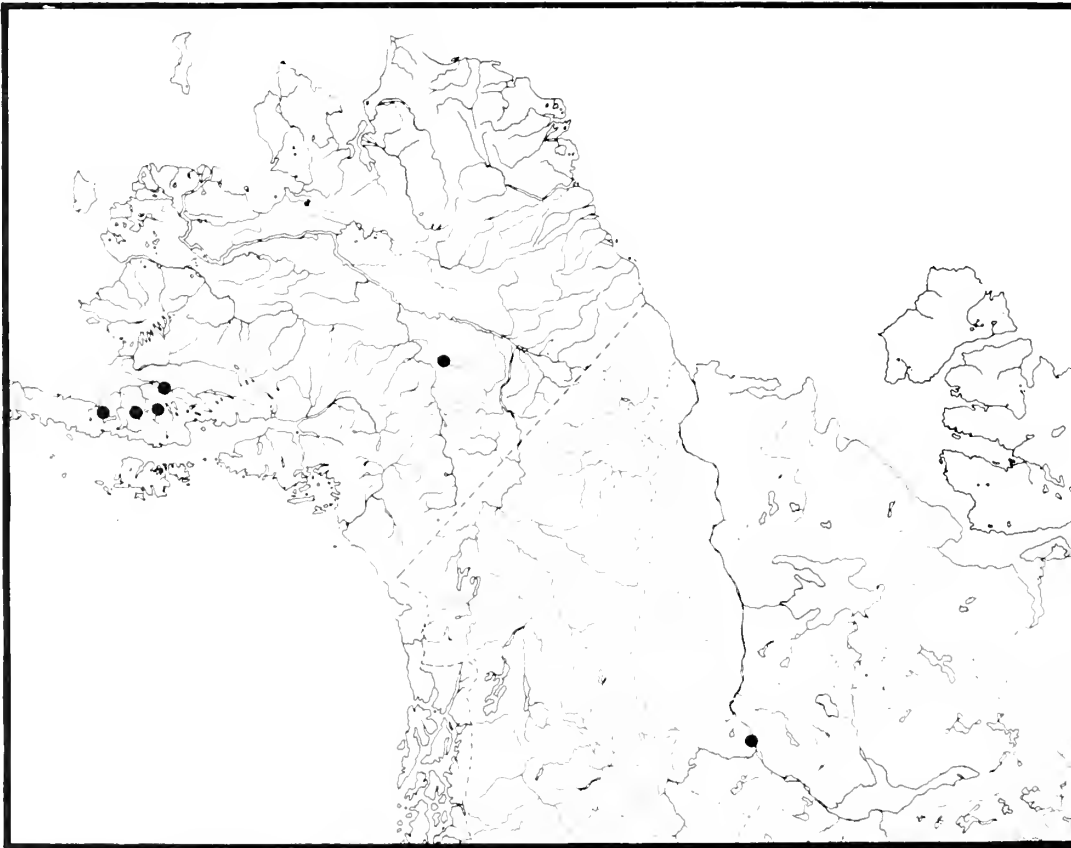
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: West Creek, tributary of Brooks Lake, Alaska Peninsula, southwestern AK (Vladykov and Kott 1978. Biol. Pap. Univ. Alaska 11:1-74).

SYSTEMATICS: *Lampetra meridionale* and *L. reissneri* distinguished from this species by lower myomere counts, and *L. japonica* by functional gut after metamorphosis and pointed teeth (gut of *L. alaskense* occluded and teeth blunt). Closest to *L. appendix* among non-parasitic species, but usually differs from it in possessing supplementary marginal teeth on lateral fields, in blunt instead of pointed intraoral and transverse lingual lamina, and in lacking gular pigmentation. This species, *L. appendix*, *L. japonicum*, *L. meridionale*, and



(NCSM)



L. reissneri recognized as belonging in genus *Lethenteron* by Vladykov and Kott (1979. Fish. Mar. Serv. Misc. Spec. Publ. 42:1-30), but 1980 AFS checklist committee retains generic name *Lampetra* for group.

DISTRIBUTION AND HABITAT: Restricted to northwestern North America; from Martin River, McKenzie River drainage, NT, west to Ugashik River, Alaska Peninsula, and north to Chatanika River, north of Fairbanks, AK. Separated from *L. appendix* by gap of 2400 km. Found in rivers and creeks.

ADULT SIZE: 120-170 mm TL, to 188 mm TL maximum.

BIOLOGY: Remains in fresh water throughout life. Spawns following transformation and without parasitic phase. Spawners taken 12 June 1976 in Chatanika River. Heard (1966. Copeia:332-39) provided life history information on *L. japonicum* and this species, to which he applied same name.

Compilers: V. D. Vladykov, E. Kott, and D. E. McAllister. September 1978.

Lampetra appendix (DeKay)
American brook lamprey

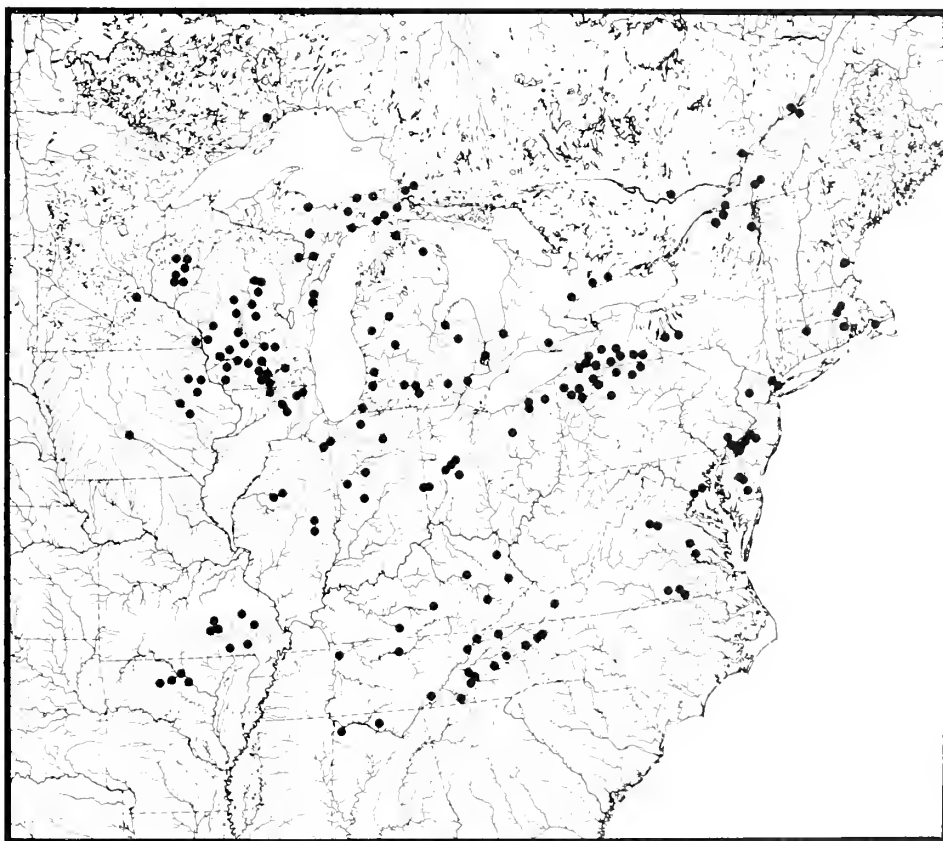
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Providence and Hudson River, NY (DeKay 1842, *Natural History of New York*, I. Zoology, 4. Fishes).

SYSTEMATICS: Subgenus *Lethenteron*. Apparently derived from parasitic *L. japonica* (Hubbs and Potter in Hardisty and Potter 1971, *The Biology of Lampreys* Vol. 1). Rohde (1979, M.A. thesis, Univ. North Carolina) recognized two subspecies. Formerly called *L. lamottei* (or *L. lamotteni*, an unauthorized emendation), but that name is considered to be unidentifiable (Bailey and Rohde, in prep.) and so next available name (*L. appendix*) must be used.



DE: Kent Co., Pratt Branch
(NCSM).



DISTRIBUTION AND HABITAT: In St. Lawrence River basin, Mississippi River basin, and on Atlantic slope from NH to Roanoke River drainage, VA. Ammocoetes found in quiet waters with mud-sand bottom in small creeks to small rivers. Adults usually taken while spawning over gravel areas near ammocoete beds.

ADULT SIZE: 99-212 mm TL, ca. 299 mm TL maximum.

BIOLOGY: Nonparasitic species. General life history given by Thomas (1962, M.S. thesis, Univ. of Toronto) and by Rohde et al. (1976, Bull. South. Calif. Acad. Sci. 75: 99-111). Moore and Beamish (1973, J. Fish. Res. Board Can. 30:7-15) reported on food habits. Hubbs (1925, Pap. Mich. Acad. Sci. Arts Lett. 4:587-603) estimated age and maturity.

Compiler: F. C. Rohde, March 1980.

Lampetra ayresi (Günther)
River lamprey

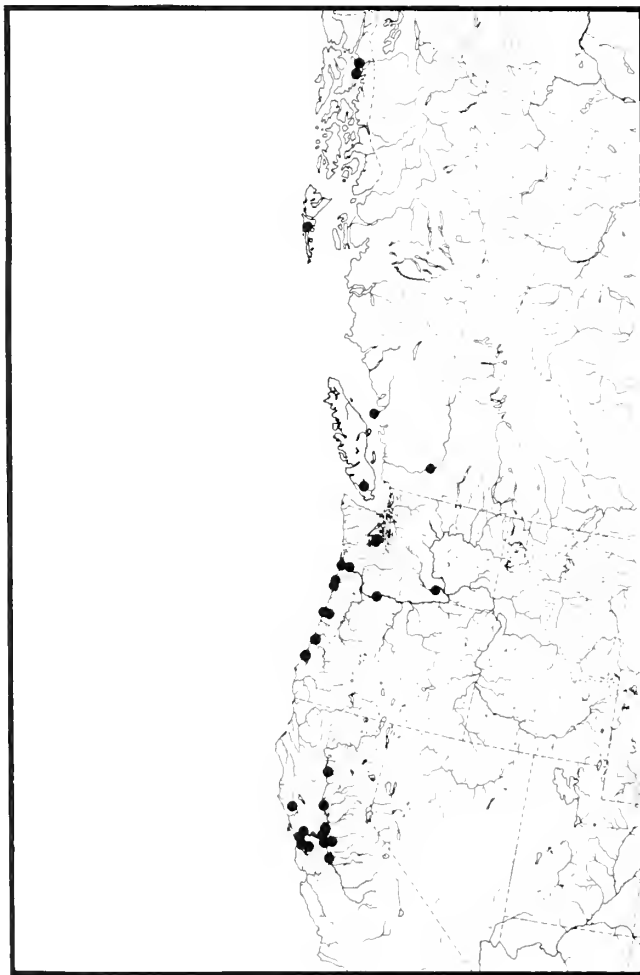
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: San Francisco Bay, CA (Günther 1870. *Catalogue of the Fishes in the British Museum* 8:1-549).

SYSTEMATICS: North American analog of European *L. fluviatilis* (Hubbs and Potter in Hardisty and Potter [eds.] 1971. *The Biology of Lampreys* (Vol. 1).



(NCSM)



DISTRIBUTION AND HABITAT: Restricted to Pacific coast, from Sacramento River, CA, to Tee Harbor near Juneau, AK (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Fresh and salt water. Ammocoetes found in streams burrowed in mud, but adults are anadromous, feeding in estuaries and at sea and spawning over gravel riffles in freshwater streams.

ADULT SIZE: ca. 120-290 mm TL, 311 mm TL maximum.

BIOLOGY: Parasitic. Scott and Crossman (1973) and Kan (1975. Ph.D. diss., Oregon State Univ.) discussed some life history aspects. Little is known about this species.

Compiler: F. C. Rohde. February 1978.

Lampetra folletti (Vladykov and Kott)

No Common Name

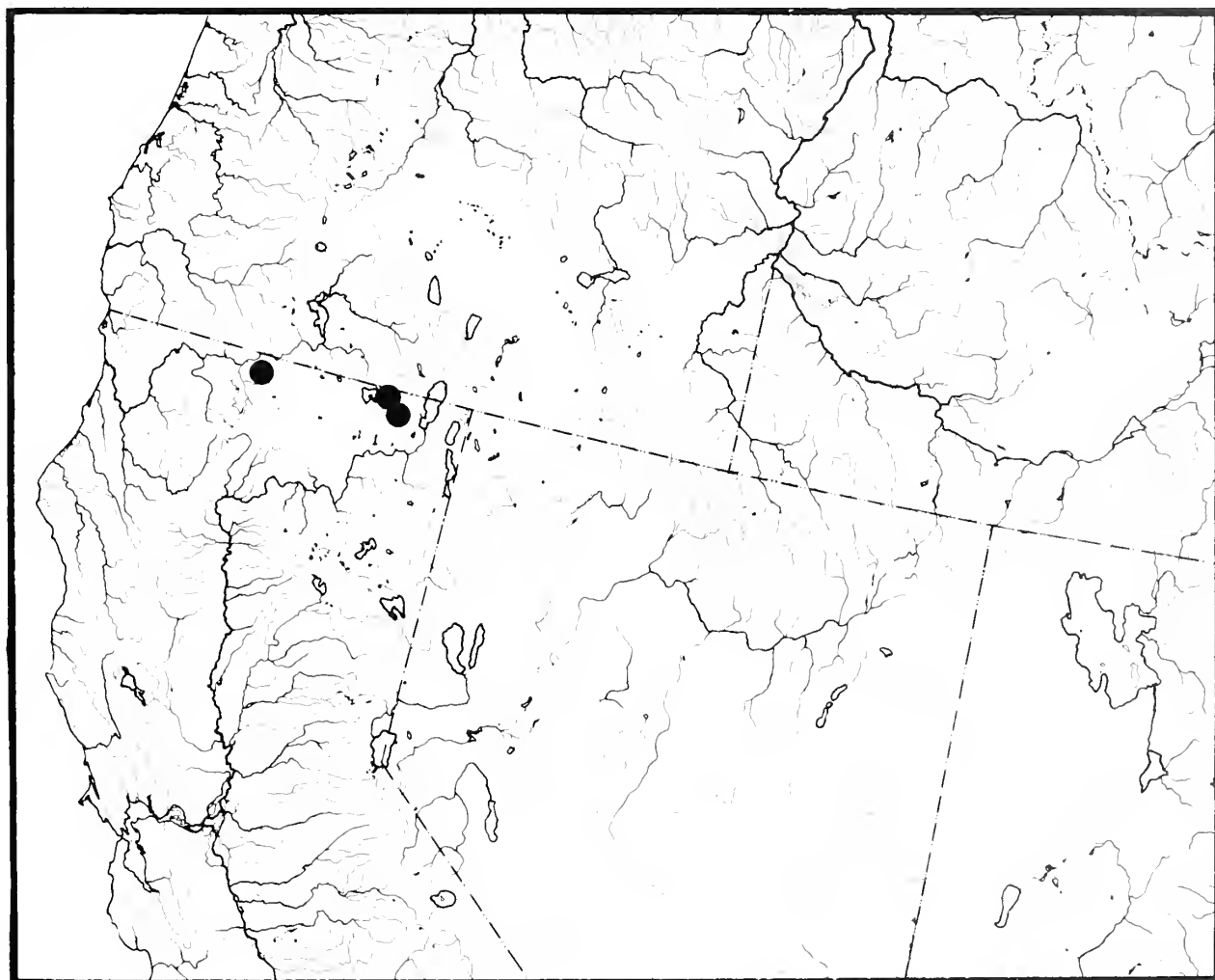
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Willow and Boles Creek, near Clear Lake Reservoir, Modoc Co., CA (Vladykov and Kott 1976. Can. J. Zool. 54:974-89).

SYSTEMATICS: Subgenus *Entosphenus*. Apparently derived from parasitic *L. tridentata*. Originally described in genus *Entosphenus*; considered a subgenus of *Lampetra* by Hubbs and Potter (in Hardisty and Potter 1971. *The Biology of Lampreys* Vol. 1), including *L. tridentata* and *L. lethophaga*. Also included in this group are subsequently described *L. folletti*, *L. hubbsi*, and *L. minima*.



(NCSM)



DISTRIBUTION AND HABITAT: Klamath River drainage of northern CA.

ADULT SIZE: ca. 186-211 mm TL, 228 mm TL maximum.

BIOLOGY: Nonparasitic species. No biological information available.

Compiler: F. C. Rohde. April 1978.

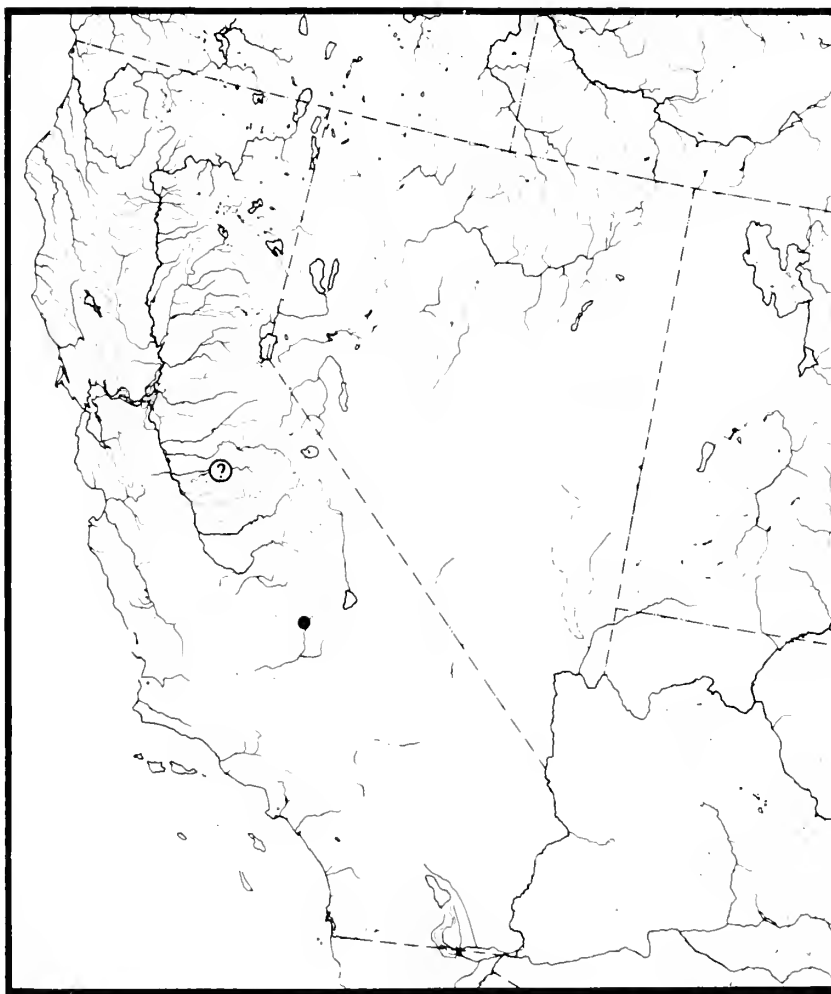
Lampetra hubbsi (Vladykov and Kott)
Kern brook lamprey

Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Canal east of Delano, Kern Co., CA (Vladykov and Kott 1976. Bull. South. Calif. Acad. Sci. 75:60-67).

ILLUSTRATION
NOT AVAILABLE

SYSTEMATICS: Apparently derived from parasitic *L. tridentata*. Originally described in genus *Entosphenus*, now considered subgenus of *Lampetra* (Hubbs and Potter in Hardisty and Potter [eds.] 1971. *The Biology of Lampreys* Vol. 1; Kan 1975. Ph.D. diss., Oregon State Univ.).



DISTRIBUTION AND HABITAT: Known only from Friant-Kern Canal, east of Delano, Kern Co., CA, which is now 85% concrete. Questionable record from San Joaquin River system based on Vladykov and Kott (1979. Misc. Sp. Publ. 42, Dept. Fish. Oceans 1-30).

ADULT SIZE: ca. 117-140 mm TL, 142 mm TL maximum.

BIOLOGY: Non-parasitic. Nothing else presently known.

Compiler: F. C. Rohde. February 1980.

***Lampetra japonica* (Martens)**
Arctic lamprey

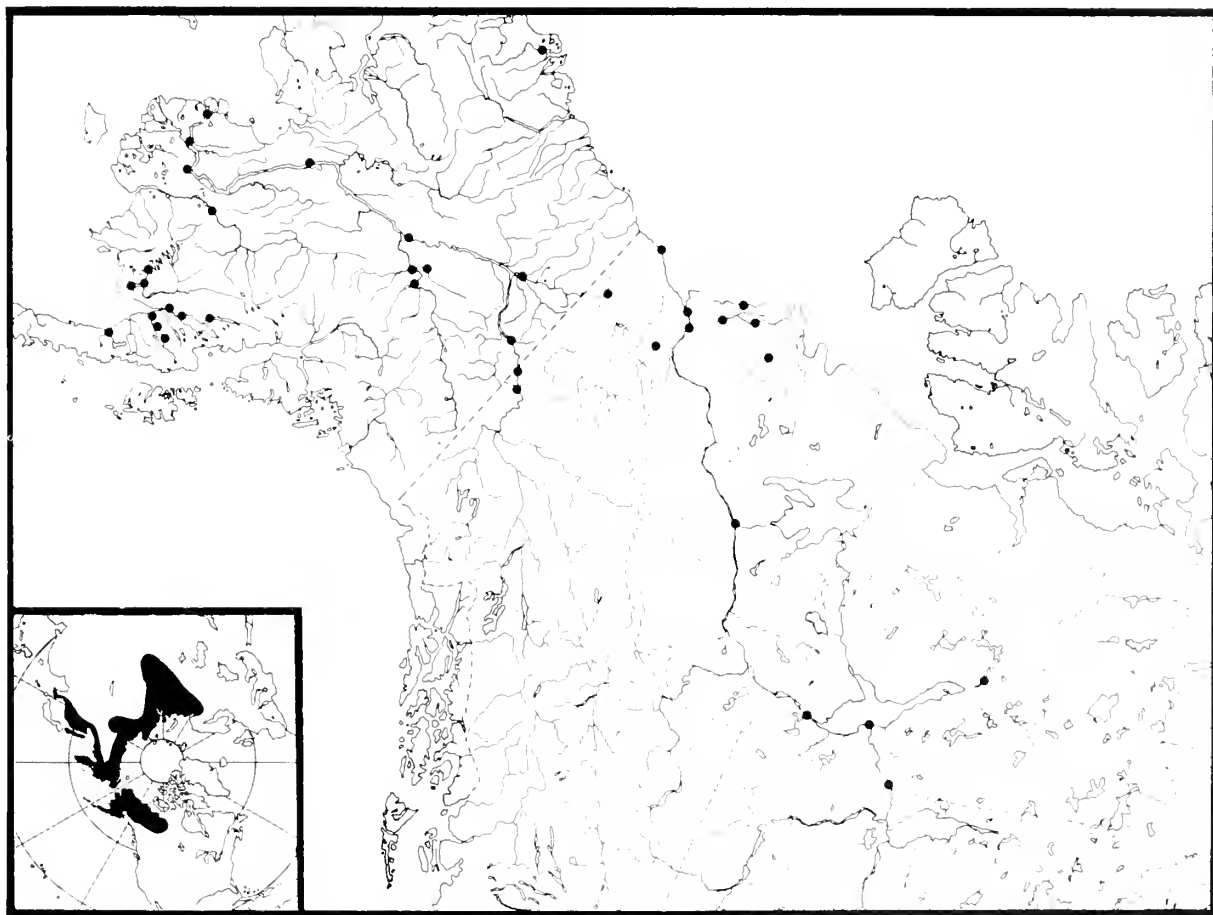
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Japan (Martens 1868. Arch. Naturgesch. 34:1-64).

SYSTEMATICS: Most primitive member of subgenus *Lethenteron*. Presumably ancestral to related nonparasitic *L. alaskense*, *L. appendix*, *L. mitsukurii*, *L. reissneri*, and *L. zanandreaei*. Vladykov and Kott (1978. Biol. Pap. Univ. Alaska 19:1-74) compared *L. japonica* with *L. alaskense*. Vladykov and Follett (1967. J. Fish. Res. Board Can. 24:1067-75) recognized *Lethenteron* as distinct genus.



ca. 23 cm TL (NMC).



DISTRIBUTION AND HABITAT: Circumpolar, ranging across eastern Europe, Asia, and northwestern North America. In AK from Kenai Peninsula north and in Canada in Anderson, Slave, Mackenzie, and Yukon rivers and Artillery and Great Slave lakes. Ammocoetes found in beds of silty mud in quiet backwaters. Adults anadromous and usually taken while spawning over gravel riffles.

ADULT SIZE: ca. 91-230 mm TL.

BIOLOGY: Parasitic, in contrast to all other *Lethenteron*. Definitive studies by Heard (1966. Copeia :332-39) and Nursall and Buchwald (1972. Fish. Res. Board Can. Tech. Rep.:1-304).

Compiler: F. C. Rohde. February 1978.

Lampetra lethophaga Hubbs
Pit-Klamath brook lamprey

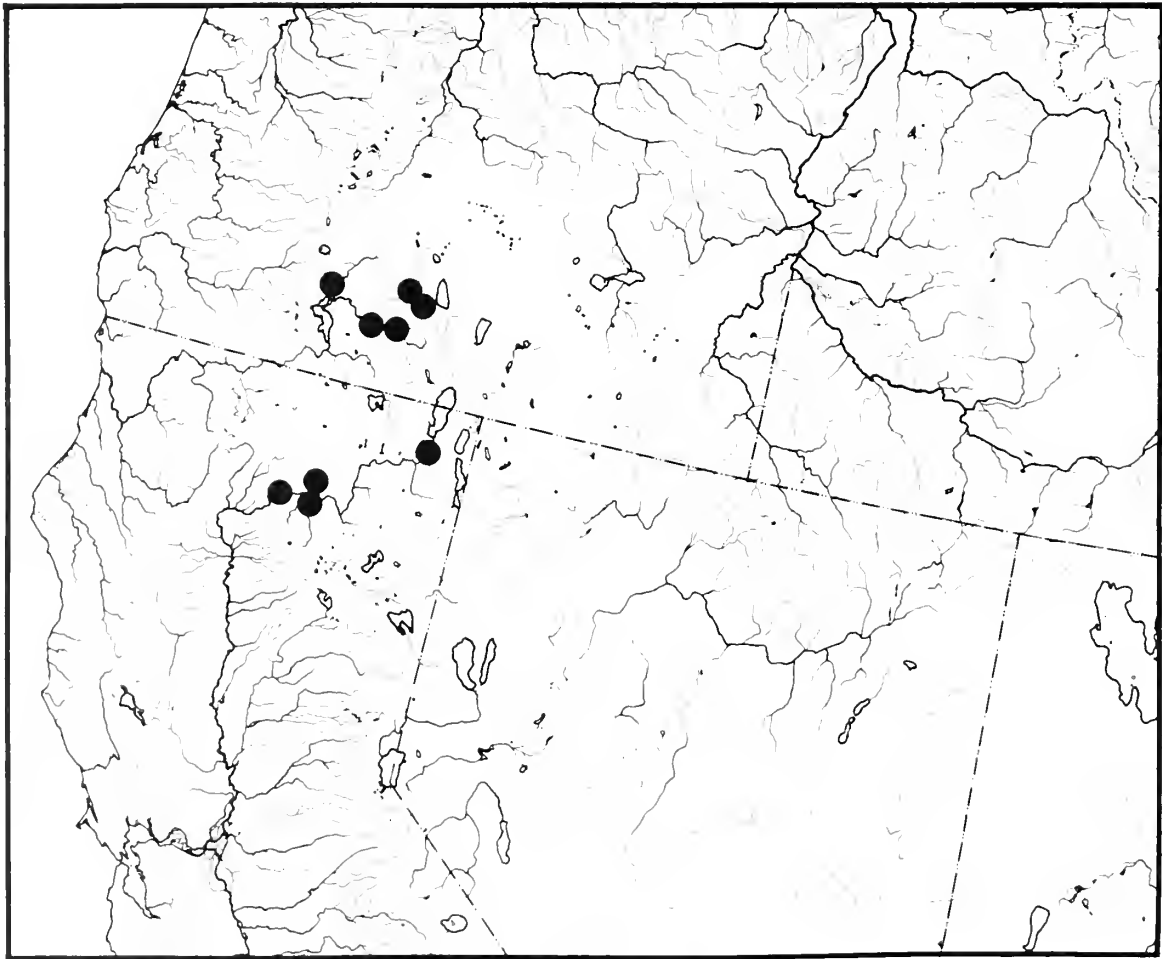
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Fall River (tributary to Pit River), Shasta Co., CA (Hubbs 1971. Trans. San Diego Soc. Nat. Hist. 16:125-64).

SYSTEMATICS: Subgenus *Entosphenus*. Derived from parasitic *L. tridentata* (Hubbs 1971). Hubbs and Potter (in Hardisty and Potter 1971. *The Biology of Lampreys* Vol. 1) included only these two species in subgenus, but *L. folletti*, *L. hubbsi*, and *L. minima* (all subsequently described) should also be included.



CA: Modoc Co., Rush Creek,
17 cm TL (Moyle 1976).



DISTRIBUTION AND HABITAT: Confined to Pit River system of northeast CA and Klamath River drainage in south-central OR. Ammocoetes found in thick weed beds and muddy-sand bars. Adults taken over gravel areas.

ADULT SIZE: 120-160 mm TL. Adults undergo regression in size attained by ammocoetes and transforming individuals. Largest ammocoete ca. 210 mm. Largest full adult ca. 170 mm.

BIOLOGY: Nonparasitic. Hubbs (1971) and Kan (1975. Ph.D. diss., Oregon State Univ.) discussed general life history. Ammocoetes live for at least four years. Metamorphosis in September or October. Some populations show evidence of neoteny (ammocoetes with ovarian development).

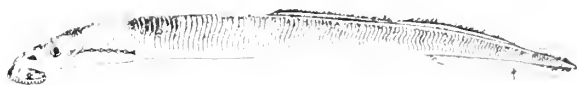
Compiler: F. C. Rohde. April 1978.

Lampetra meridionale (Vladykov,
Kott, and Pharand-Coad)
Gulf brook lamprey

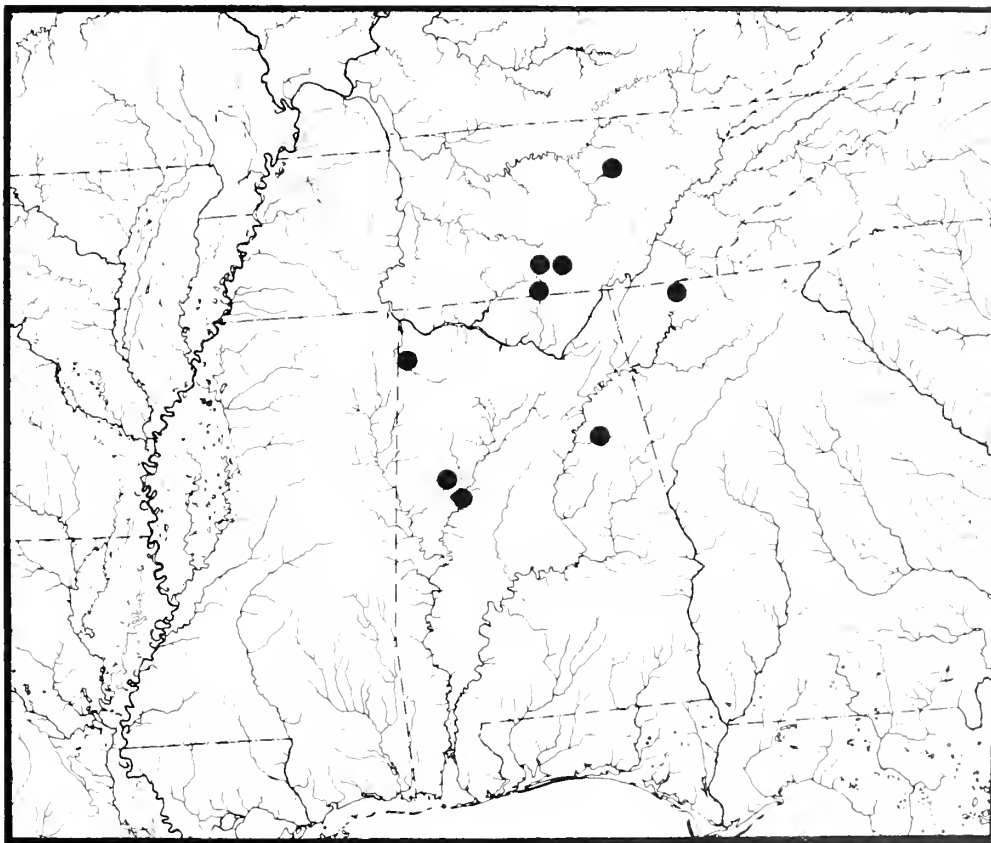
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Tributary of Tennessee River, near Hillsboro, Coffee Co., TN (Vladykov, Kott, and Pharand-Coad 1975. Nat. Mus. Nat. Sci. Publ. Zool. 12:1-36).

SYSTEMATICS: Closest relative is *L. acyptera*, and may be synonymous. Originally described as *Lethenteron*, which most authors refer to as subgenus of *Lampetra*.



NCSM



DISTRIBUTION AND HABITAT: Only in TN, AL, and GA, in Cumberland and Tennessee river drainages and Mobile Bay basin. Restricted to medium and small creeks. Ammocoetes in quieter areas in mud; adults taken over gravel.

ADULT SIZE: ca. 96-136 mm TL, 141 mm TL maximum.

BIOLOGY: Nonparasitic. Biology presumably similar to that of *L. acyptera*. (Rohde et al. 1976. Bull. South. Calif. Acad. Sci. 75:99-111).

Compiler: F. C. Rohde. February 1978.

Lampetra minima Bond and Kan
Miller Lake lamprey

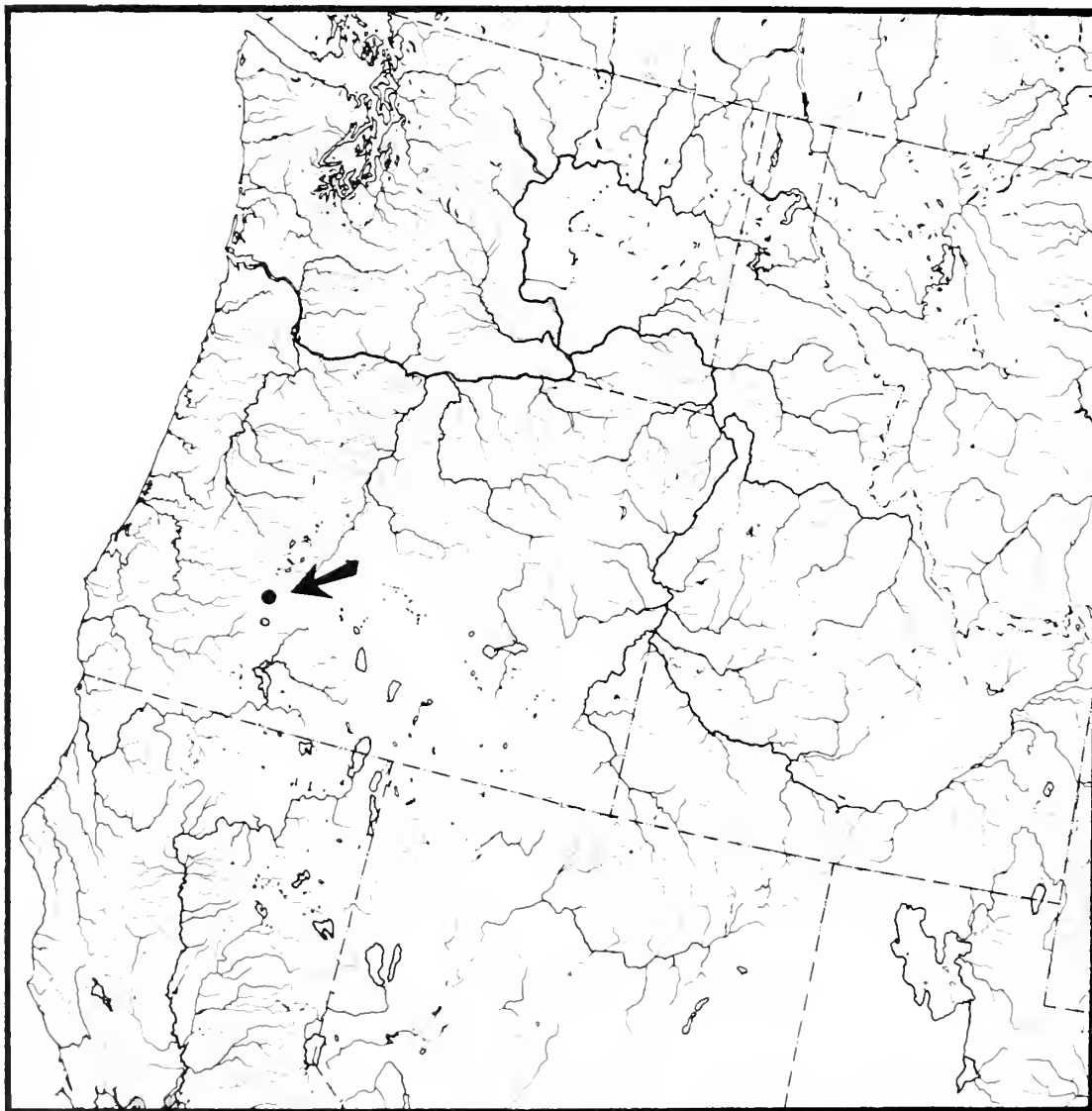
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Miller Lake, Klamath Co., OR (Bond and Kan 1973. Copeia: 568-74).



SYSTEMATICS: Subgenus *Entosphenus*. Hubbs and Potter (in Hardisty and Potter 1971, *The Biology of Lampreys* Vol. 1.) included only *L. tridentata* and *L. lethophaga* in this subgenus, to which should be added *L. folletti*, *L. hubbsi*, and *L. minima*.

OR: Klamath Co., Miller Lake,
99 mm TL (NCSM).



DISTRIBUTION AND HABITAT: Formerly endemic to Miller Lake, OR.

BIOLOGY: Parasitic; exterminated during fish-counting operations because of predation on introduced trout. Adults live more than one year. Kan (1975. Ph.D. diss., Oregon State Univ.) reviewed general life history.

ADULT SIZE: ca. 72-125 mm TL, 129 mm TL maximum.

Compiler: F. C. Rohde. April 1978.

Lampetra pacifica Vladykov
Pacific brook lamprey

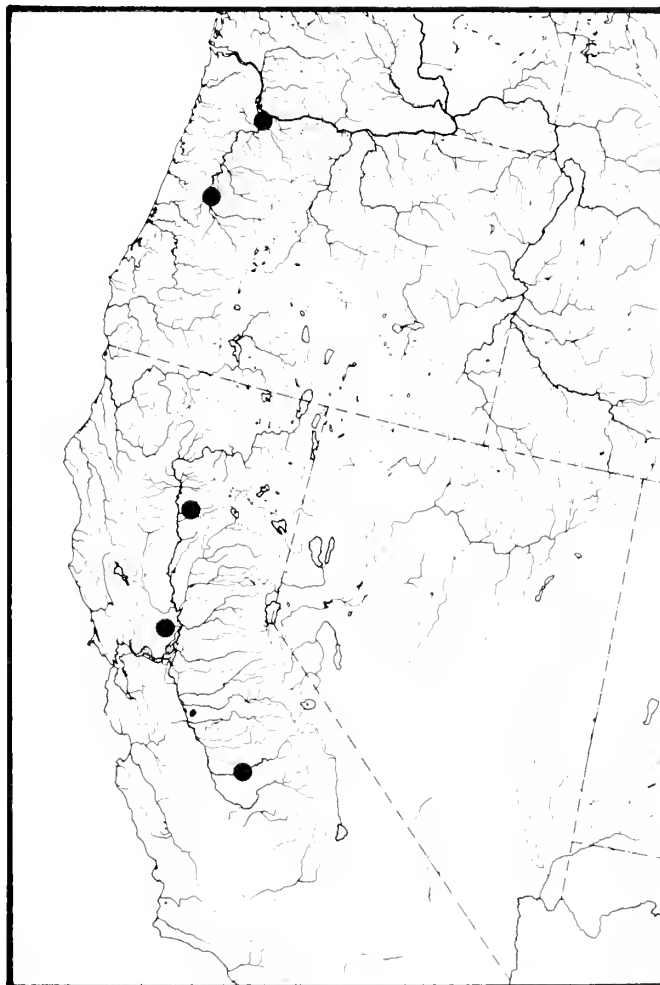
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Clackamas River, tributary to Columbia River, near Eastacada, OR (Vladykov 1973. J. Fish. Res. Board Can. 30:205-13).

SYSTEMATICS: Apparently derived from parasitic *L. ayresi*. Kan (1975. Ph.D. diss., Oregon State Univ.) regarded *L. pacifica* a synonym of *L. richardsoni*.



17 cm TL (Moyle 1976).



DISTRIBUTION AND HABITAT: Tributaries of Sacramento River and in San Joaquin River, CA, and Columbia River basin, OR (Vladykov 1973).

ADULT SIZE: ca. 98-169 mm TL, 173 mm TL maximum.

BIOLOGY: Nonparasitic. Kan (1975) reviewed general life history of similar or conspecific *L. richardsoni*.

Compiler: F. C. Rohde. April 1978.

Lampetra richardsoni Vladykov
and Follett
Western brook lamprey

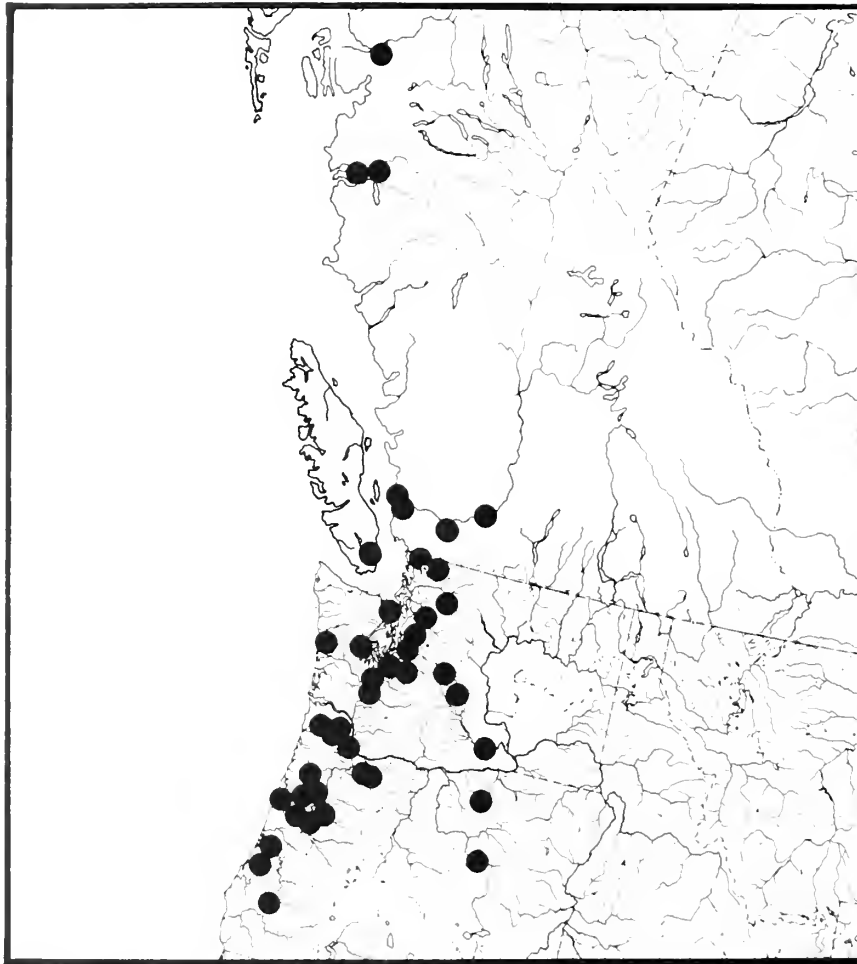
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Smith Creek, Cultus Lake, BC (Vladykov and Follett 1965. J. Fish. Res. Board Can. 22:139-58).

SYSTEMATICS: Derived from parasitic *L. ayresi* (Vladykov and Follett 1965). Referred to as *L. planeri* in earlier publications (e.g., Schultz 1930. Occas. Pap. Mus. Zool. Univ. Mich. 221:1-35).



(NCSM)



DISTRIBUTION AND HABITAT: Streams of Pacific coast from OR to BC and possibly AK (Vladykov and Follett 1965). Ammocoetes found in eddies of streams where rich deposits of silt, mixed with some sand, settle. Adults usually taken over gravel riffles while spawning.

ADULT SIZE: ca. 101-149 mm TL, 154 mm TL maximum.

BIOLOGY: Nonparasitic. McIntyre (1969. J. Fish. Res. Board Can. 26:3252-54) discussed spawning behavior. Schultz (1930), Scott and Crossman (1973. *Freshwater Fishes of Canada*), and Kan (1975 Ph.D. diss., Oregon State Univ.) reviewed life history. Spawns from late April to early June. Egg number varies from 1,100-37,000. Ammocoete life span up to six years. Transform August-November and adults die after spawning.

Compiler: F. C. Rohde. February 1978.

Lampetra similis (Vladykov and Kott)
Klamath River lamprey

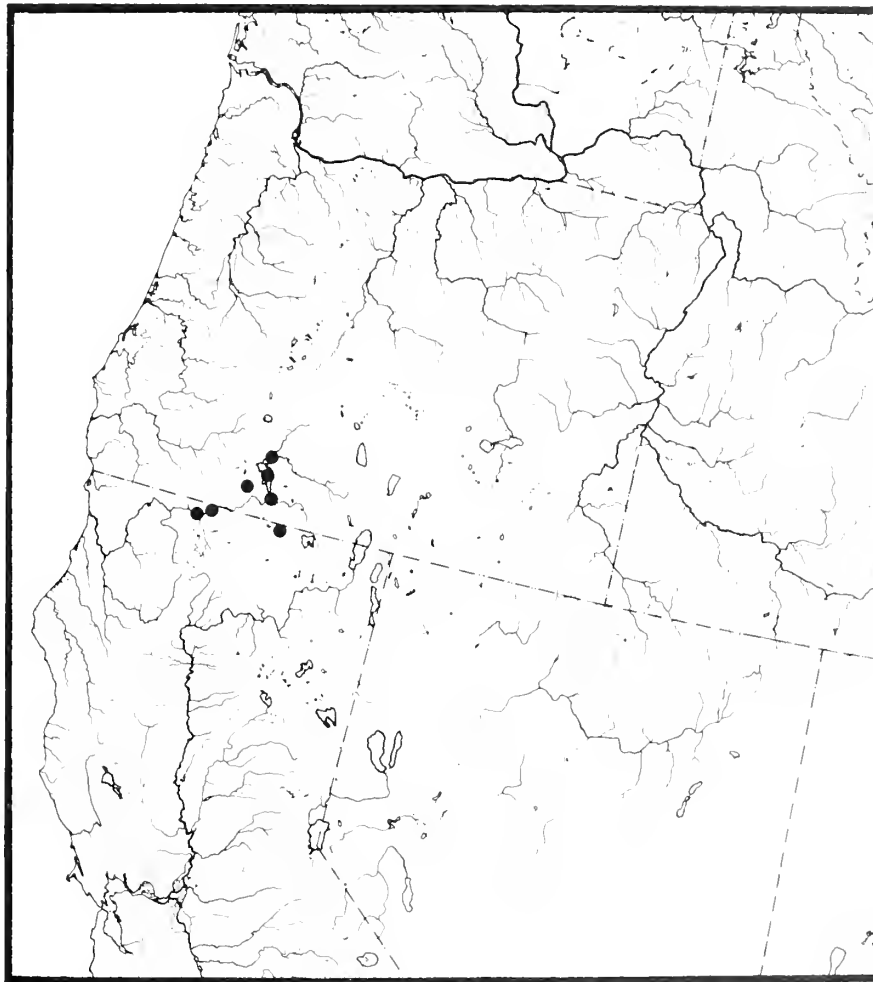
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Klamath River, CA
(Vladykov and Kott 1979. Can. J. Zool. 57:
808-23).

SYSTEMATICS: Originally described in
genus *Entosphenus*. Vladykov and Kott
(1976. Can. J. Zool. 54:421-25; 1979. Can.
Fish. Mar. Serv. Misc. Spec. Publ. 42:1-30)
provided evidence that *Entosphenus* is dis-
tinct from *Lampetra*. Closest relative is
E. tridentatus. This species is not recognized
by the 1980 AFS checklist committee.



(NCSM)



DISTRIBUTION AND HABITAT: Found
in the Klamath River drainage of CA and
OR. Typically in lakes and impoundments
or large rivers.

ADULT SIZE: Usually 136 - 247 mm TL,
to 269 mm TL maximum.

BIOLOGY: Parasitic. Apparently restricted
to fresh water. Nothing else is presently
known.

Compiler: E. Kott. March 1980.

Lampetra tridentata (Gairdner)
Pacific lamprey

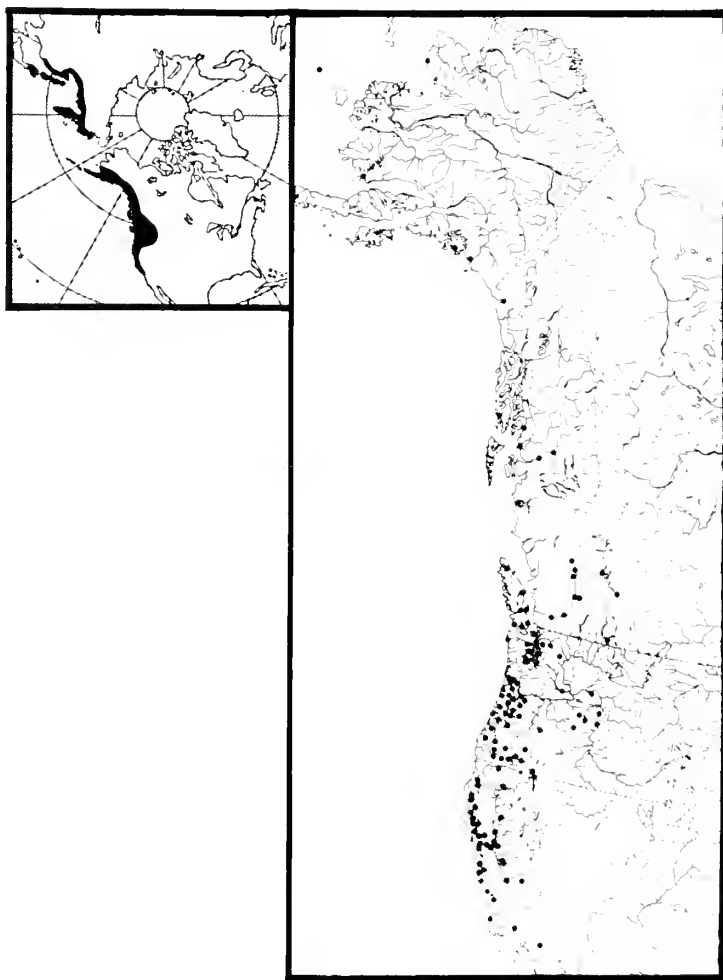
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: Falls of Walamet (now Willamette), OR (Gairdner in Richardson 1836. *Fauna Boreali-Americana*).

SYSTEMATICS: Subgenus *Entosphenus*. Most primitive member of subgenus, which many authors recognize as a genus, which includes *L. folletti*, *L. hubbsi*, and *L. minima*. Kan (1975. Ph.D. diss., Oregon State Univ.) recognized two subspecies: a wide-ranging form and one landlocked in the Klamath Basin and Goose Lake drainages.



Kamchatka (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Wide-ranging, anadromous species of Pacific Ocean. Spawning adults and ammocoetes found in rivers of western seaboard from AK to southern CA. Ammocoetes found in shallow backwater and eddy areas along edges of streams in mud, silt, or silt and sand.

ADULT SIZE: ca. 130-690 mm TL, 760 mm TL maximum.

BIOLOGY: Parasitic. Spawning usually starts in April when water reaches 8.5°C. *Lampetra t. tridentata* has more eggs but lower relative fecundity than the landlocked subspecies. Ammocoetes are from four to six years old at transformation in late September and October. Duration of parasitic stage from 20 to 40 months (Kan 1975).

Compiler: F. C. Rohde. February 1978.

Petromyzon marinus Linnaeus
Sea lamprey

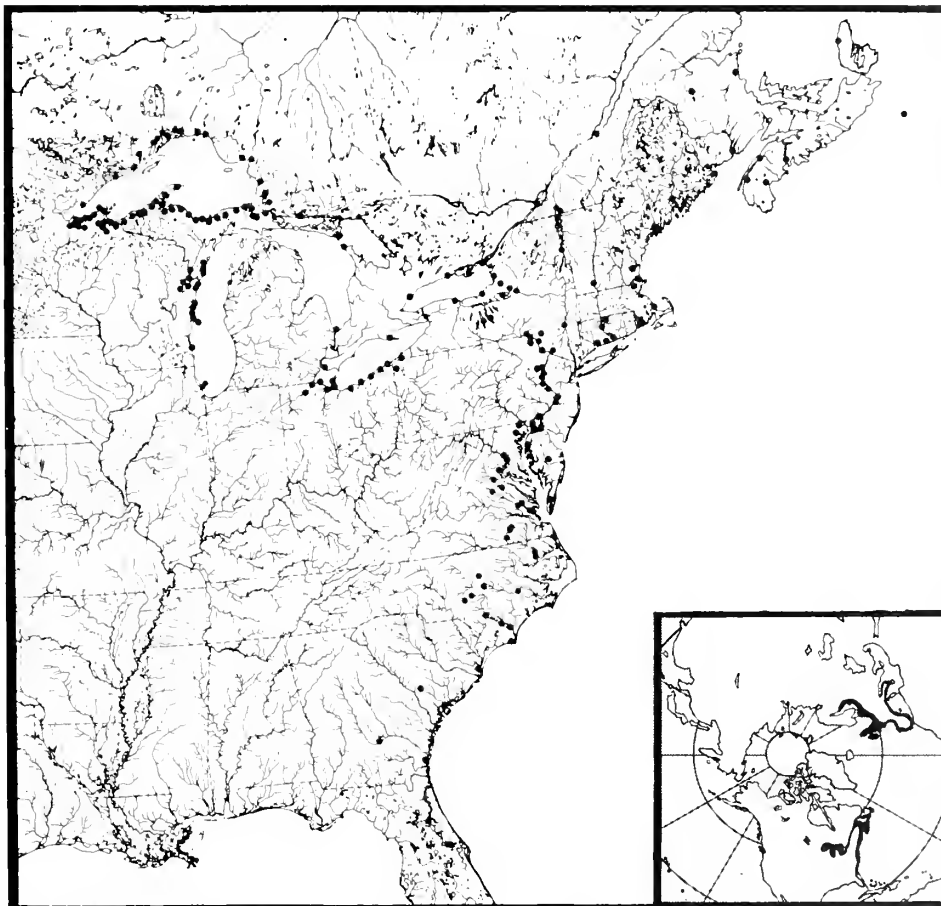
Order Petromyzontiformes
Family Petromyzontidae

TYPE LOCALITY: "European seas" (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Appears close to ancestral stock from which *Lampetra* arose (Hubbs and Potter in Hardisty and Potter 1971. *The Biology of Lampreys* Vol. 1).



MA: Woods Hole (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Both sides of Northern Atlantic. Along east coast from Labrador to FL, in Great Lakes, and landlocked in several NY lakes. Not originally native to upper Great Lakes (above Lake Ontario), since prevented from entering by Niagara Falls. Construction of Welland Canal allowed it to bypass this barrier. Present in Europe from Norway south to Mediterranean. Populations with direct access to the sea are anadromous. Populations in upper Great Lakes and several inland lakes in NY remain in fresh water. Ammocoetes found in streams and eddies or pools with areas of sandy silt and mud. Adults usually taken while migrating to or at spawning areas of gravel riffles.

ADULT SIZE: ca. 135-860 mm TL, maximum 1200 mm TL anadromous, 558 mm TL landlocked.

BIOLOGY: Parasitic. Much work done on this species, principally in Great Lakes (Applegate 1950. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. 55:1-237; Manion and McLain 1971. Great Lakes Fish Comm. Tech. Rep. 16:1-35; Potter and Beamish 1977. J. Zool. Lond. 181:113-30). Applegate (1950) found that adults in lakes Huron and Michigan survive between 12-20 months. Wigley (1959. U.S. Fish Wildl. Serv., Fish. Bull. 59:561-617; 1959. U.S. Fish Wildl. Serv., Res. Rep. 44:1-32) found that ammocoetes in Lake Cayuga live seven years before transforming. Severe economic pest in certain places, particularly upper Great Lakes where has been directly responsible for extermination of two and possibly three endemic *Coregonus*.

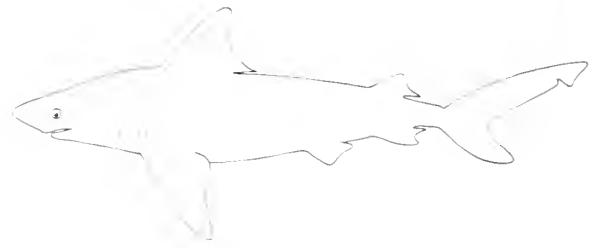
Compiler: F. C. Rohde. March 1978.

Carcharhinus leucas (Valenciennes)
Bull shark

Order Squaliformes
Family Carcharhinidae

TYPE LOCALITY: "Antilles" (Valenciennes in Müller and Henle 1841. Syst. Besch. Plagiost.:1-204).

SYSTEMATICS: Systematics of *C. leucas*-*C. gangeticus* group currently confused, but J. A. F. Garrick will soon publish revision of genus. *Carcharhinus azureus* from eastern Pacific is synonym (Kato et al. 1967. U.S. Fish. Wildl. Serv. Circ. 271:1-47). All sharks in this species group difficult to distinguish, and may represent a single species.



2335 mm TL (Schwartz and Burgess 1975. *Sharks of North Carolina and Adjacent Waters*).



DISTRIBUTION AND HABITAT: Euryhaline and circumtropical, frequently shallow coastal waters and often encountered in low salinity situations. Only shark that ascends rivers into fresh waters of North America. The five North American freshwater records are from Atchafalaya and Red rivers, LA (Gunter 1938. Copeia:69-72), Mississippi River, IL (Thomerson et al. 1977. Copeia:166-68), Aucilla River, FL (Swift et al. 1977. Bull. Tall Timbers Res. Sta. 20:1-111), and Apalachicola River, FL (pers. obs.). In Atlantic, ranges from Chesapeake Bay (and possibly occasionally as far north as Woods Hole, MA) to Brazil, including Bermuda, Gulf of Mexico, and Caribbean islands. In Pacific, known from Anacapa Island, CA (Fry and Roedel 1945. Calif. Fish Game 31:1-209) to Ecuador and probably northern Peru (Kato et al. 1967).

ADULT SIZE: 225-305 cm TL (males), 233-300 cm TL (females).

BIOLOGY: Opportunistic predator of fishes (especially sharks and rays), porpoises, crustaceans, mollusks, sea turtles, and refuse (Bigelow and Schroeder 1948. *Sharks in Mem. Sears Found. Mar. Res.* 1[1]:59-576; Springer in Gilbert [ed.] 1963. *Sharks and Survival*: 95-113; Clark and von Schmidt 1965. Bull. Mar. Sci. 15:13-83). Clark and von Schmidt (1965) presented length-weight relationships and noted that 5-10 young (74-75 cm TL) are born in April-June in central Gulf coast of FL. Gulf of Mexico population migratory (Springer 1963), but further information on populations dynamics and age and growth lacking. Biological data reported by Bass et al. (1973. Oceanogr. Res. Inst. Invest. Rep. 33:1-168) for South African populations may be useful in United States waters. Potentially dangerous to man and responsible for several documented attacks.

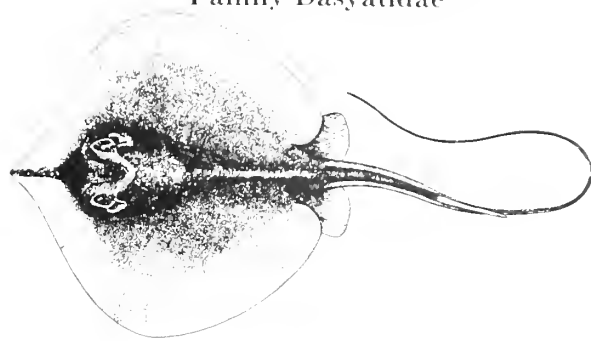
Compilers: G. H. Burgess and S. W. Ross.
December 1978.

Dasyatis sabina (Lesueur)
Atlantic stingray

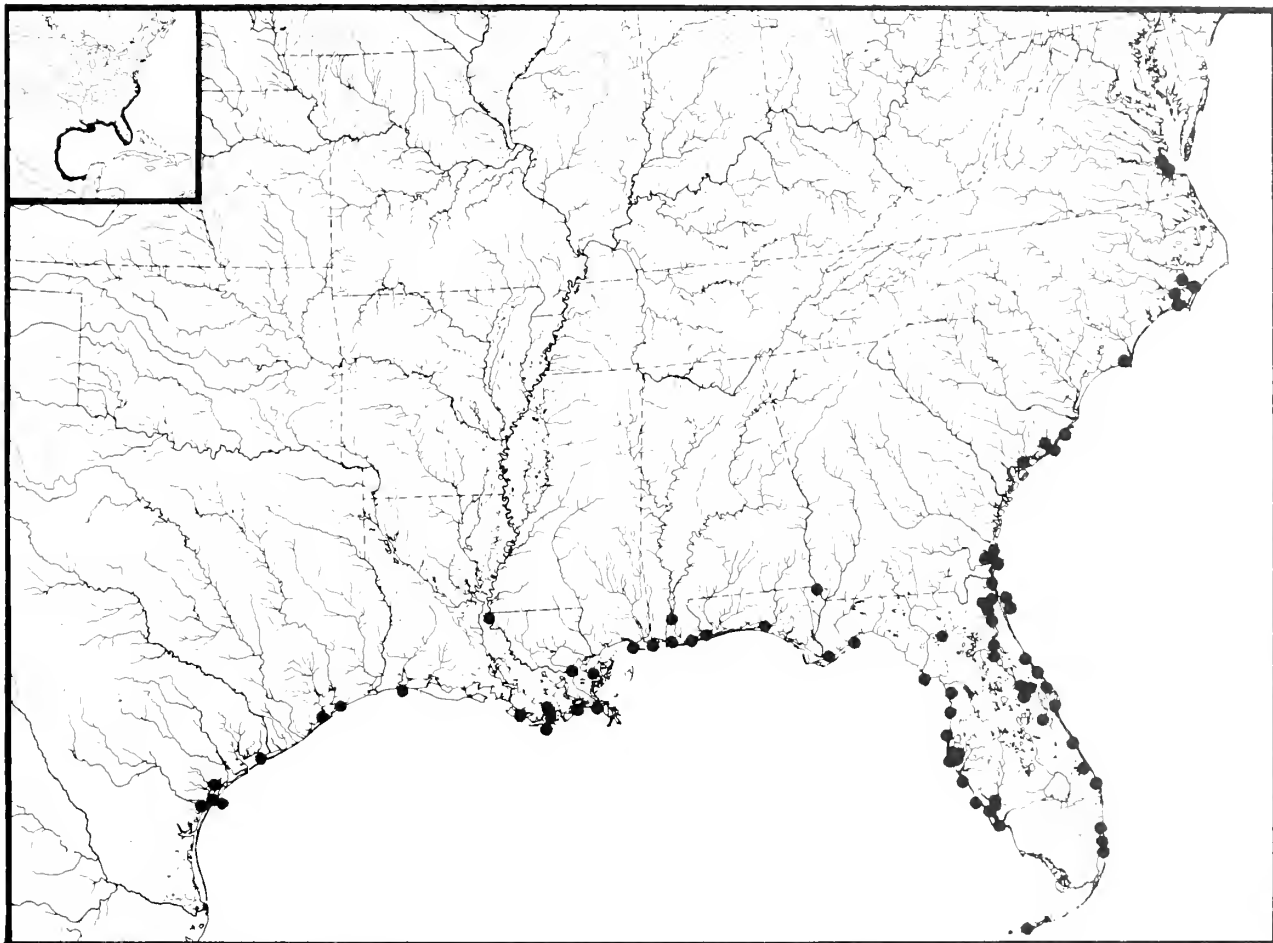
Order Myliobatiformes
Family Dasyatidae

TYPE LOCALITY: "Florida" (Lesueur 1824. J. Acad. Nat. Sci. Phila. 4:100-21).

SYSTEMATICS: Smallest western Atlantic *Dasyatis*. Closest relatives are eastern Atlantic *D. pastinaca* and *D. margarita* (Bigelow and Schroeder 1953. Sawfishes, Guitarfishes, Skates and Rays in Mem. Sears Found. Mar. Res. 1[2]:1-514). Often confused with sympatric *D. sayi*.



TX: Galveston (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Common resident of shallow (usually less than 10 m) coastal waters from Chesapeake Bay to Mexico, possibly farther south. Center of abundance is northern Gulf of Mexico and FL. Only North American stingray commonly entering fresh water; often abundant in St. Johns River, FL. Moves out of shallow estuaries in winter into more thermally stable near-shore waters (Gunter 1945. Publ. Inst. Mar. Sci. 1:1-190; Bigelow and Schroeder 1953; Sage et al. 1972. Contr. Mar. Sci. 16:71-74). Generally prefers soft bottom habitats.

ADULT SIZE: 190 mm DW males, 206 mm DW females; 610 mm DW maximum.

BIOLOGY: Diet usually composed of crustaceans, polychaetes, and amphipods (Bigelow and Schroeder 1953). Exact spawning season undetermined, but probably from spring through early fall, depending on locality. Sage et al. (1972) documented seasonal distribution and growth in TX, and Funicelli (1975. Ph.D. diss., Univ. Southern Mississippi) studied seasonal distribution, food habits, taxonomy, and sex ratios of Mississippi Sound and northern Gulf populations. Schwartz and Dahlberg (1978. Northeast Gulf Sci. 2:1-23) reported aspects of biology and ecology.

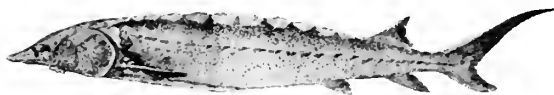
Compilers: S. W. Ross and G. H. Burgess.
December 1978.

Acipenser brevirostrum Lesueur
Shortnose sturgeon

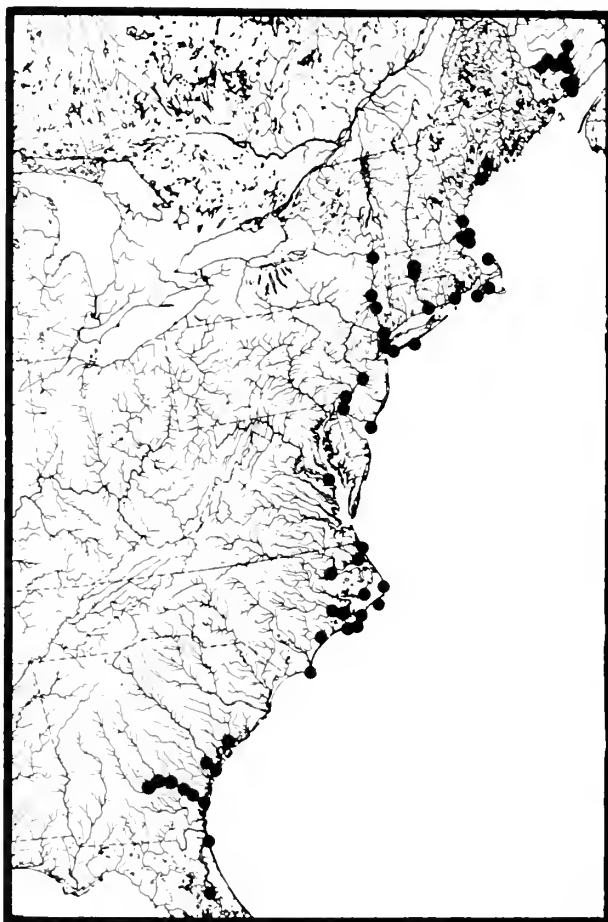
Order Acipenseriformes
Family Acipenseridae

TYPE LOCALITY: Delaware River (Lesueur 1818. Trans. Am. Philos. Soc. 1:383-94).

SYSTEMATICS: Closely related to *A. fulvescens*. Vladykov and Greeley (1963. Order Acipenseroidei in Mem. Sears Found. Mar. Res. 1[3]:24-60) summarized systematics, and Gorham and McAllister (1974. Syllogeus 5:1-18) illustrated species and compared it with *A. oxyrinchus*. *Acipenser brevirostris* of authors is unjustified emendation of original spelling.



MA: Woods Hole, ca. 69 cm SL
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Coastal waters, including lakes and rivers, from St. Johns River, FL, north to St. John River, NK. Uncommon in Canada, endangered in United States. Only records since 1949 are from St. Johns River, FL (1949 and 1977); Connecticut River, MA; Hudson River, NY; Sheepscot and Kennebec rivers, ME; and St. John River, NK. Records from St. Lawrence River, QU, based on misidentifications. Occurs in fresh, estuarine, and salt water. Gilbert and Heidt (1979. ASB Bull. 26:35) reported several from Altamaha River, GA, beyond mouth of Ocmulgee River.

ADULT SIZE: 400-900 mm FL.

BIOLOGY: Dadswell (1975. Rep. Environ. Can. :1-67) intensively studied biology of NK population. McCleave et al. (1977. Copeia :149-57) reported on daily movements in Montsweag Bay, ME. Gorham and McAllister (1974) and Vladykov and Greeley (1963) reviewed biology. Probably spawns at peak flows in brackish reaches of tidal rivers from April to June. Matures at 500-600 mm when 4-16 years old and lives to 50-60 years. Feeds on molluscs, crustaceans, annelids, insects, and incidentally plant material.

Compilers: C. G. Gruchy and B. Parker.
May 1979.

Acipenser fulvescens Rafinesque
Lake sturgeon

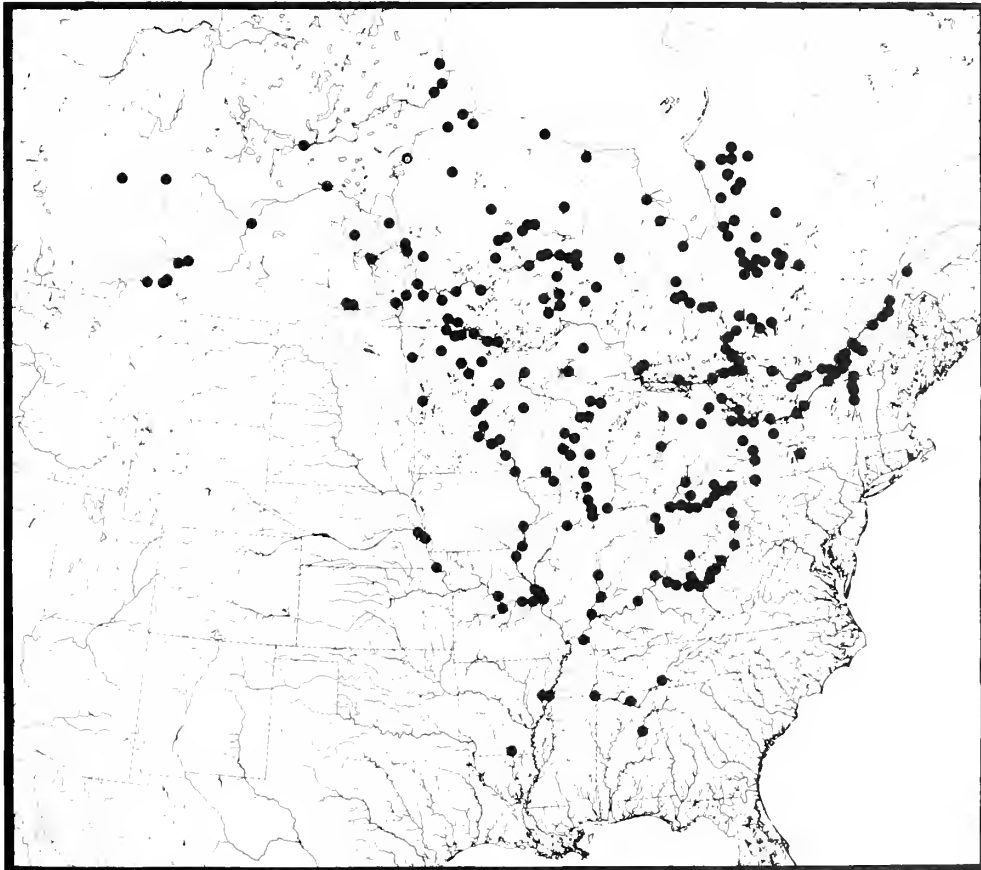
Order Acipenseriformes
Family Acipenseridae

TYPE LOCALITY: Lake Erie (Rafinesque 1817. Am. Mon. Mag. Crit. Rev. 1:288). Description repeated in Hubbs (1917. Copeia: 44:48).

SYSTEMATICS: Roussow (1955. Ann. de l'Acfas 21:79-85) described two morphae, *A. f. acutirostris* and *A. f. obtusirostris*.



QU: St. Lawrence River
(NMC).



DISTRIBUTION AND HABITAT: From Seal River, MB, on west coast of Hudson Bay, west in Saskatchewan River drainage to Brazeau River, AT; east to Cape Brule, St. Lawrence estuary, QU, and west of Appalachians south to Coosa River system, AL (Scott 1951. Trans. Amer. Fish. Soc. 80: 28-40). Primarily benthic, in shoal areas of lakes and large rivers, usually in 5-9 m depth over mud or gravel bottoms. Infrequently enters brackish water in Canada.

BIOLOGY: Spawns May-June between 13-18°C at 1-5 m depth in fast water. Adhesive eggs, scattered over rocks and logs, hatch in 5-8 days. Mature at 14-20 years, males about 750-1000 mm and females 800-1200 mm, and may live to 120 years. Food includes crayfish, molluscs, insects, and fish eggs. Seldom preyed on by other fishes but attacked by lampreys. Harkness and Dymond (1961. Ont. Dept. Lands Forests, Fish Wild. Br.: 1-121) and Magnin (1966. Verh. Int. Verein. Limnol. 16: 1018-24) surveyed reproduction.

ADULT SIZE: 900-1400 mm FL.

Compilers: C. G. Gruchy and B. Parker.
September 1978.

Acipenser medirostris Ayres
Green sturgeon

Order Acipenseriformes
Family Acipenseridae

TYPE LOCALITY: San Francisco, CA (Ayres 1854. Daily Placer Times and Transcript. May 30. Repeated in 1857. Proc. Calif. Acad. Nat. Sci. [1854-57] 1:3-22).

SYSTEMATICS: Kirsch and Fordice (1889. Proc. Acad. Nat. Sci. Phila.41:245-57) reviewed American species of sturgeons. Scott and Crossman (1973. *Freshwater Fishes of Canada*), Hart (1973. *Pacific Fishes of Canada*) and Moyle (1976. *Inland Fishes of California*) provided illustrations, descriptions, and keys.



CA: Klamath River Estuary,
22 cm TL (Moyle 1976).



DISTRIBUTION AND HABITAT: Coastal areas of North Pacific. In Asia known from China, northern Japan, Korea, and USSR north to Amur River, and in North America from Gulf of Alaska to southern CA. Anadromous but rarely encountered in fresh water. Usually in mouths and lower reaches of large rivers, and bays and sounds. Only in Trinity and Klamath rivers, CA, is it known to ascend rivers for any distance. Less common than *A. transmontanus*.

ADULT SIZE: ca. 1.3 m FL, ca. 2.13 m. FL maximum.

BIOLOGY: Scott and Crossman (1973) and Moyle (1976) summarized known information, which is much less than that for *A. transmontanus*. Found in mouths of rivers in August and September; apparently moves into fresh water in fall and winter, spawning in spring. Chadwick (1959. Calif. Fish Game 45:297-301) reported on movements of tagged individuals in CA. Not commercially important.

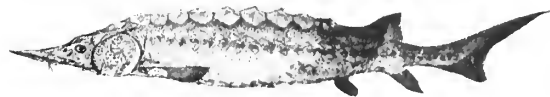
Compiler: D. S. Lee. January 1979.

Acipenser oxyrinchus Mitchill
Atlantic sturgeon

Order Acipenseriformes
Family Acipenseridae

TYPE LOCALITY: "New York" (Mitchill 1815. Trans. N.Y. Lit. Philos. Soc. N.Y. 1:355-492).

SYSTEMATICS: Magnin (1964. Nat. Can. 91:5-20) showed that nearctic *A. oxyrinchus* is closely related to, but specifically distinct from, palaearctic *A. sturio*. Two allopatric subspecies recognized, *A. o. oxyrinchus* and *A. o. desotoi*, distinguished by Vladykov and Greeley (1963. Order Acipenseroidei in Mem. Sears Found. Mar. Res. 1[3]:24-60).

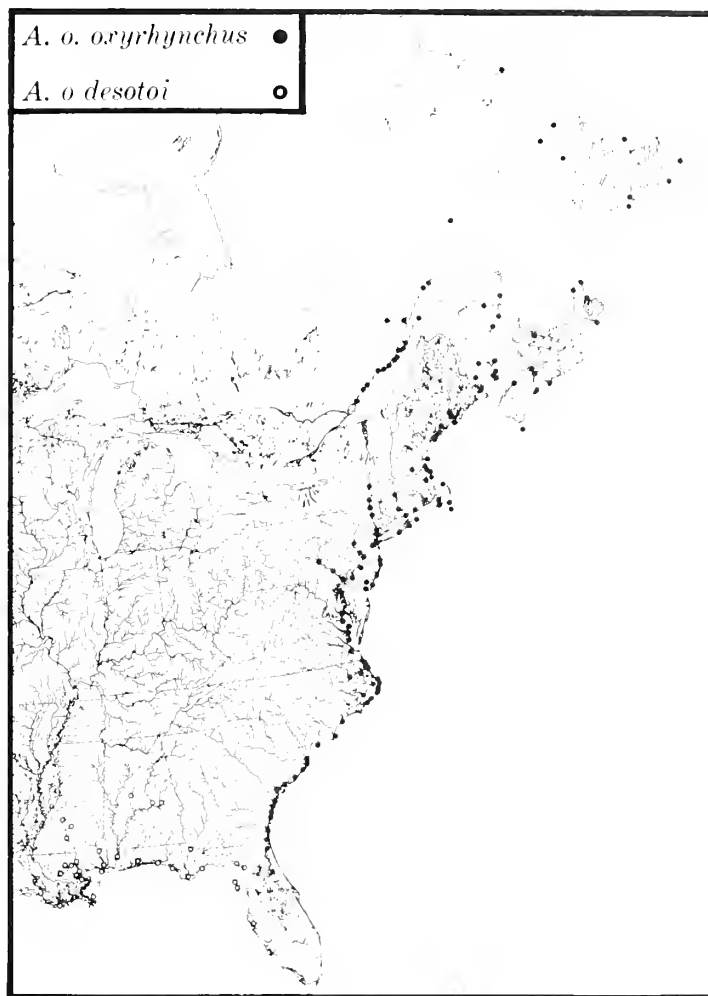


Potomac River (Jordan and Evermann 1900).

DISTRIBUTION AND HABITAT: *Acipenser o. oxyrinchus* ranges from Hamilton River, Labrador, or George River, Ungava Bay, to northeastern FL (where no records since 1900). Also recorded from Bermuda. At one time an isolated, relict population may have lived off northeastern South America, one specimen having been reported over 100 years ago (basis for description of *A. cayennensis*). *Acipenser o. desotoi* confined to northeastern Gulf of Mexico, where ranges from Mississippi delta east to Suwannee River, FL, and formerly to Tampa Bay. Greatly depleted throughout most of range and now relatively common only in a few areas.

ADULT SIZE: 880-2000 mm FL.

BIOLOGY: Vladykov and Greeley (1963) summarized biology. Huff (1975. Fla. Mar. Res. Publ. 16:1-32) published on life history of *A. o. desotoi* of Suwannee River, FL. Spawns from February in south to July in north, up to depths of 11-13 m, at 13° to 18° C. Eggs adhere to vegetation and stones and hatch in about seven days. Mature between 10 and 28 years of age and may attain age of 60 years. Young descend to sea at about four years of age and migrate up to 1500 km; have been captured on Georges and Browns banks off NS. Feeds on insects, crustaceans, molluscs, annelids, and occasionally small fishes.



Compilers: C. G. Gruchy and B. Parker.
September 1978.

Acipenser transmontanus Richardson
White sturgeon

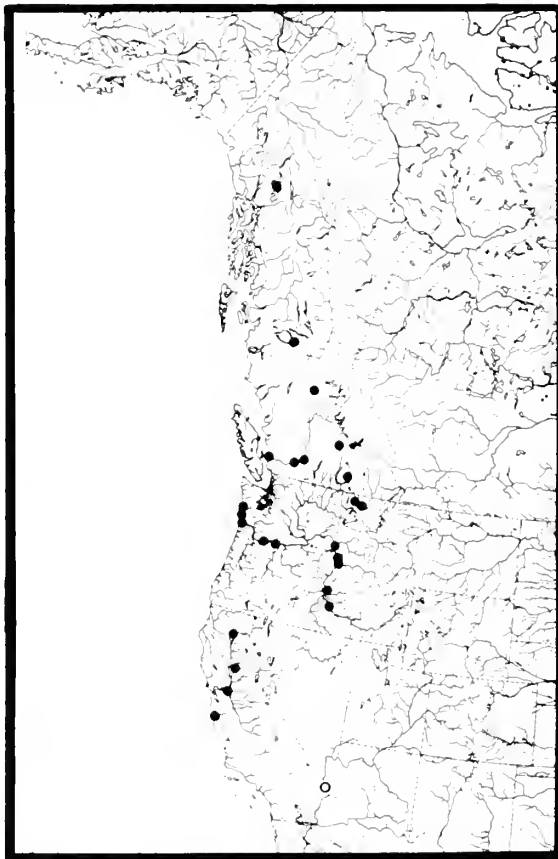
Order Acipenseriformes
Family Acipenseridae

TYPE LOCALITY: Fort Vancouver, Columbia River (Richardson 1836. *Fauna Boreali-Americana* 3:1-327).

SYSTEMATICS: Kirsch and Fordice (1889. Proc. Acad. Nat. Sci. Phila. 41:245-57) reviewed American species of sturgeons. Scott and Crossman (1973. *Freshwater Fishes of Canada*), Hart (1973. *Pacific Fishes of Canada*), and Moyle (1976. *Inland Fishes of California*) provided illustrations, description and keys.



CA: Sacramento-San Joaquin Delta, 52 cm TL (Moyle 1976).



Open circle transplanted population

DISTRIBUTION AND HABITAT: Pacific slope of North America from Aleutian Islands, AK, to Monterey, CA. Anadromous, spending most time in sea near shore but known from depths of 30 m. Ascends far inland in large rivers to spawn. Land-locked population in upper Columbia River. Encountered much more frequently than *A. medirostris*. Introduction in lower Colorado River of unknown success (Minekley 1973. *Fishes of Arizona*).

BIOLOGY: Good summaries provided by Scott and Crossman (1973. *Freshwater Fishes of Canada*), Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) and Moyle (1976) from which the following is taken. Adults move into large rivers in early spring and spawn by May and June. Females spawn at 4 to 11 year intervals. A 348 cm individual estimated to be 82 years old, and largest individuals probably live over 100 years. Movements at sea not well known. More piscivorous than other North American sturgeons. Once commercially important, but over-fishing led to commercial extinction by turn of century.

ADULT SIZE: ca. 80 - 340 cm FL.

Compiler: D. S. Lee. January 1979.

***Scaphirhynchus albus* (Forbes and
Richardson)
Pallid sturgeon**

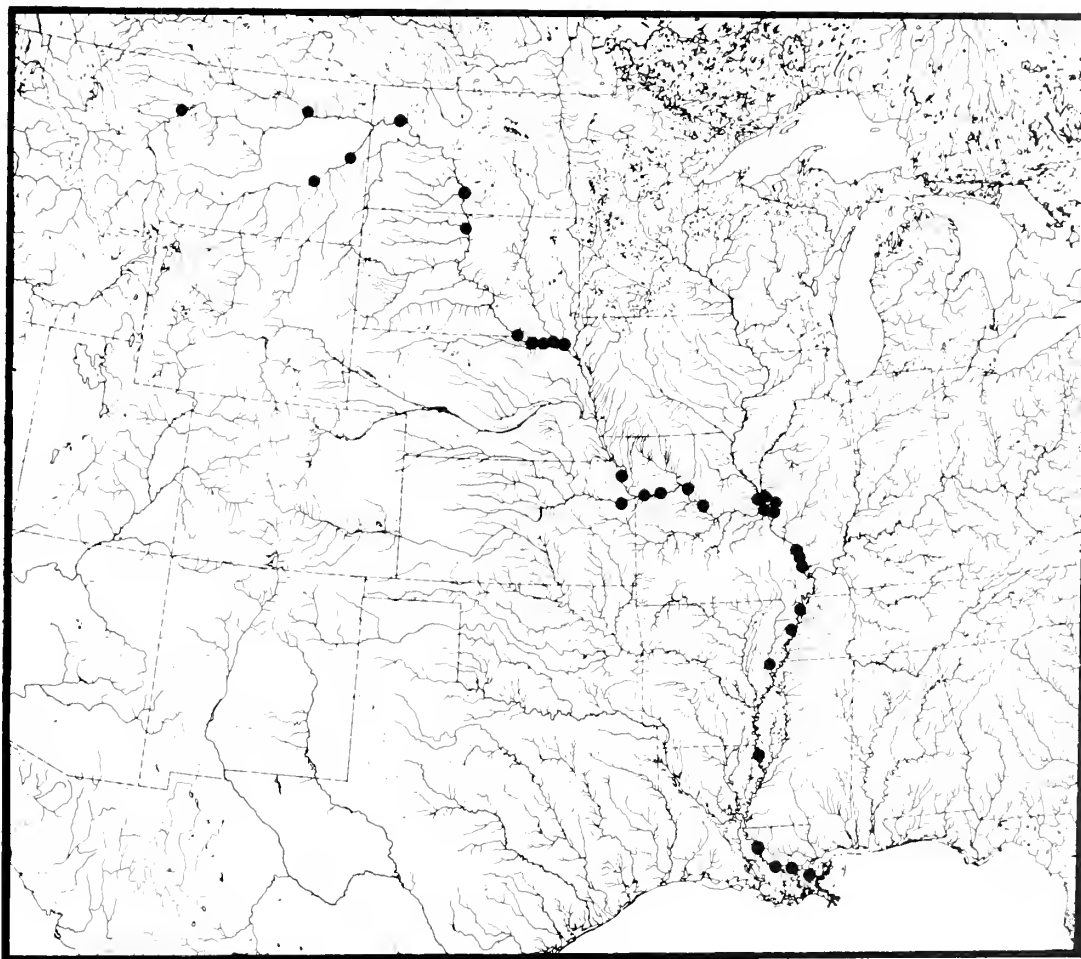
Order Acipenseriformes
Family Acipenseridae

TYPE LOCALITY: Mississippi River, at or near Grafton, IL (Forbes and Richardson 1905. Bull. Ill. State Lab. Nat. Hist. 7:37-44).

SYSTEMATICS: One of four genera in family, one of two genera in subfamily Scaphirhynchinae, and one of two (possibly three) species in genus. Bailey and Cross (1954. Pap. Mich. Acad. Sci. Arts Lett. 39:169-208) reviewed systematics of genus.



(NCSM)



Map modified from Bailey and Cross 1954

DISTRIBUTION AND HABITAT: Almost entirely restricted to main channels of Missouri and lower half of Mississippi rivers. Prefers excessively turbid waters (to a much greater degree than *S. platyrhynchus*) in areas of strong current over a firm sand bottom. Generally much scarcer than *S. platyrhynchus*, usually outnumbered at least 20 to 1 in areas where both occur.

ADULT SIZE: 533-838 mm TL. 1100 mm SL maximum.

BIOLOGY: One of the most poorly known and infrequently seen North American freshwater fishes. Spawns in June and July (Forbes and Richardson 1920. *The Fishes of Illinois*) and feeds on aquatic insects and small fishes (Coker 1929. Bull. U. S. Bur. Fish. 45:141-225). Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) summarized available age, length, and weight data.

Compiler: D. S. Lee. February 1978.

Scaphirhynchus platyrhynchus
(Rafinesque)
Shovelnose sturgeon

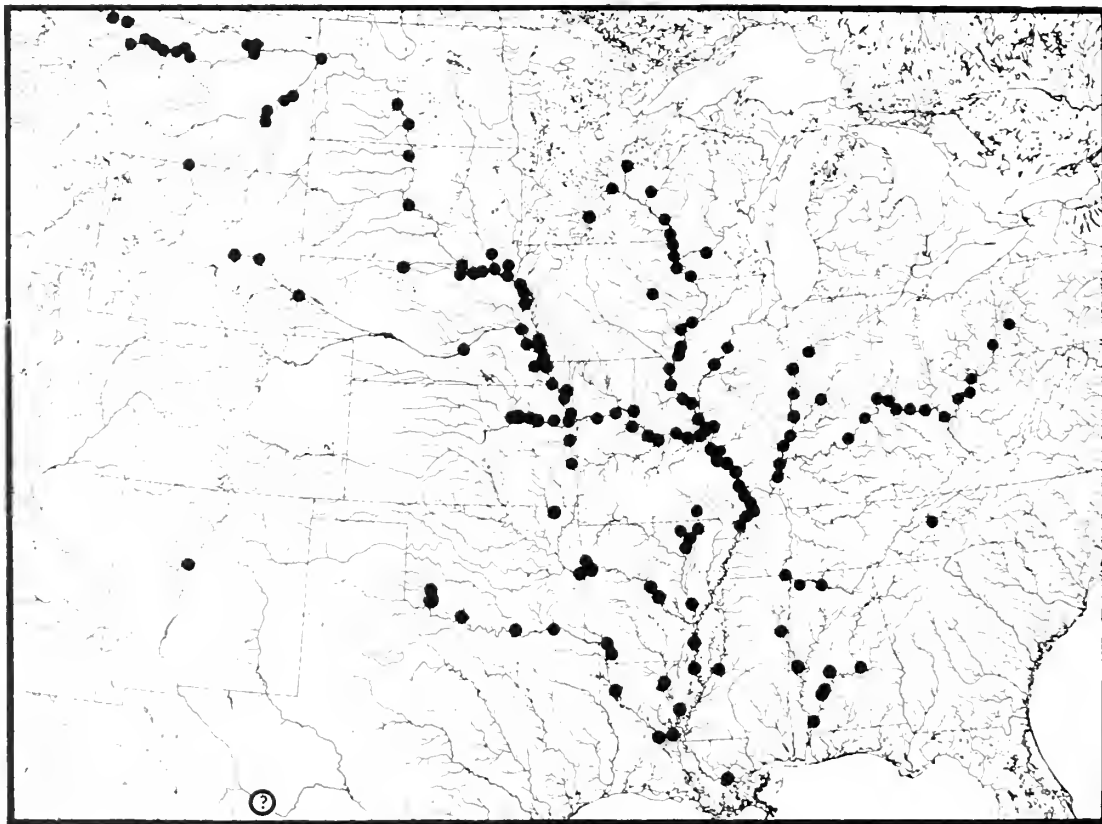
Order Acipenseriformes
Family Acipenseridae

TYPE LOCALITY: No specific locality designated, "Ohio, Wabash, and Cumberland rivers, seldom reaching as high as Pittsburg; also in Mississippi and Missouri rivers" (Rafinesque 1820. *Ichthyologia Ohiensis*).



SYSTEMATICS: One of two genera in subfamily Scaphirhynchinae, and one of two (possibly three) species in genus. Bailey and Cross (1954. Pap. Mich. Acad. Sci. Arts Lett. 39:169-208) reviewed systematics. A closely related, undescribed, and nearly extinct form from Mobile Bay drainage, AL, is currently under study by J. D. Williams and G. H. Clemmer.

(Jordan and Evermann 1900)



Map modified from Bailey and Cross 1954

DISTRIBUTION AND HABITAT: Throughout much of Mississippi and Missouri rivers and portions of their largest tributaries. Formerly occurred in upper Rio Grande in NM, but not recorded there since 1874. Usually in channels of rivers, inhabiting areas of strong current and sand or gravel substrate. Occurs in waters of high turbidity, but apparently less tolerant of such conditions than *S. albus*. Seldom very common, but always more so than *S. albus*.

ADULT SIZE: 526-605 mm FL, 853 mm FL maximum.

BIOLOGY: Small amount of available information summarized by Coker (1929. Bull. U. S. Bur. Fish. 45:141-225), Held (1969. Trans. Am. Fish. Soc. 98:514-17), and Pflieger (1975. *The Fishes of Missouri*). Spawning apparently occurs from April to early July in channels of large rivers over rocky bottoms. Individuals mature and spawn at five to seven years of age. Aquatic insect larvae make up the bulk of diet. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) summarized available age, length, and weight data.

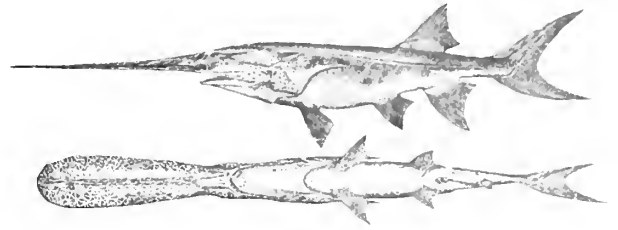
Compiler: D. S. Lee. February 1978.

***Polyodon spathula* (Walbaum)**
Paddlefish

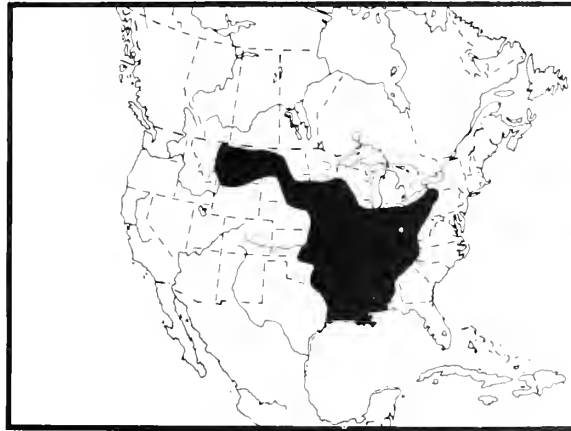
Order Acipenseriformes
Family Polyodontidae

TYPE LOCALITY: Not given (Walbaum in Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Two living species in family: *P. spathula* of central North America, and *Psephurus gladius* of Yangtze River, China. Myers (1949. *Bijdr. Tot Dierk.* 28:315-22) stated that a third species from Mississippi River remains to be described but this is unconfirmed. Close relationship with sturgeons (Acipenseridae) further substantiated by chromosome number and morphology and possible tetraploidy (Dingerkus and Howell 1976. *Science* 194:842-44), and by a coelenterate parasite that infects eggs of members of both families (Suppes and Meyer 1976. *J. Parasitol.* 61:772-74).



OH: Cincinnati (Jordan and Evermann 1900).



See map on next page

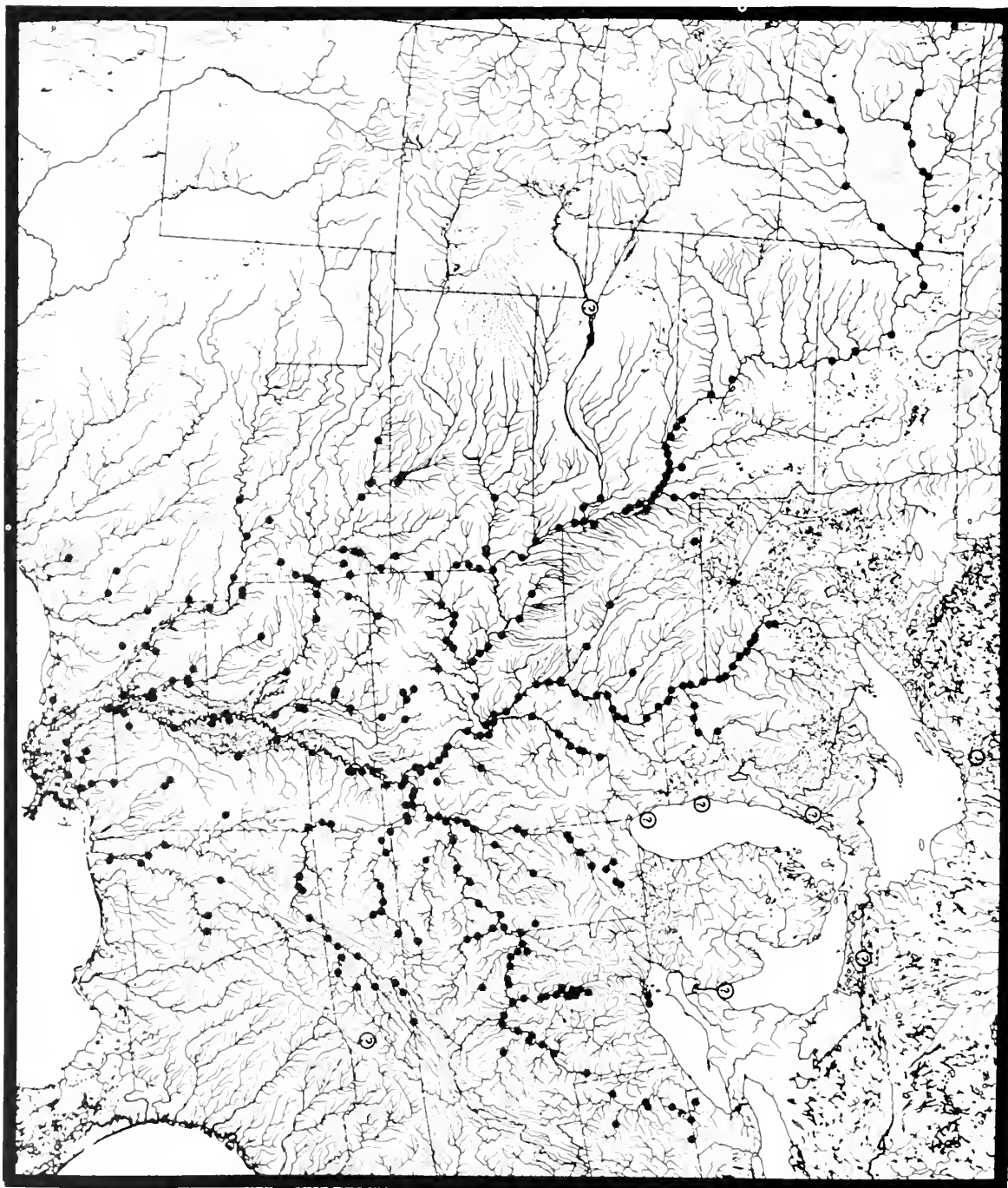
DISTRIBUTION AND HABITAT: Formerly common in large bodies of water throughout much of Mississippi Valley and adjacent Gulf slope drainages, from San Jacinto River, TX, east to Mobile Bay basin, AL. Confirmed from saline waters. Known with certainty in Lake Erie prior to 1903 (Trautman 1957. *The Fishes of Ohio*), but of uncertain status in remaining Great Lakes, where reported to occur around turn of century (Hubbs and Lagler 1964. *Fishes of the Great Lakes Region*). Apparently declining in recent years throughout parts of range because of habitat loss and over-fishing. Prefers large, free-flowing rivers rich in zooplankton, but frequents impoundments with access to spawning sites. Occurred in ON (Halkett 1906. *Ann. Rep. Dept. Marine Fish.* 362; Halkett 1913. *Checklist of the Fishes of the Dominion of Canada and Newfoundland*) but now extirpated in Canada.

BIOLOGY: Stockard (1907. *Am. Nat.* 41: 753-66) and Robinson (1966. *Mont. Acad. Sci.* 26:33-44) gave information on general life history and movements. Food habits reported by Eddy and Simer (1929. *Trans. Ill. State Acad. Sci.* 21:59-68) and Fitz (1966. *Copeia*: 356). Adams (1942. *Am. Midl. Nat.* 28:617-30), Houser and Bross (1959. *Trans. Am. Fish. Soc.* 88:50-52), Purkett (1961. *Trans. Am. Fish. Soc.* 90:125-29; 1963. *Prog. Fish. Cult.* 25:31-33), and Ballard and Needham (1964. *J. Morph.* 114:465-78) discussed age and growth, reproduction, development, and propagation. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), Pflieger (1975. *The Fishes of Missouri*), and Vasetskiy (1971. *J. Ichthyol.* 11:18-31) provided most complete general summaries. Graham and Bonislawsky (1978. *An Indexed Bibliography of the Paddlefish*: 1-12) provided a bibliography.

ADULT SIZE: 890-1505 mm TL.

Compiler: B. M. Burr. December 1978.

Distribution of paddlefish, *Polypodon spathulatus*



Atractosteus spatula (Lacepede)
Alligator gar

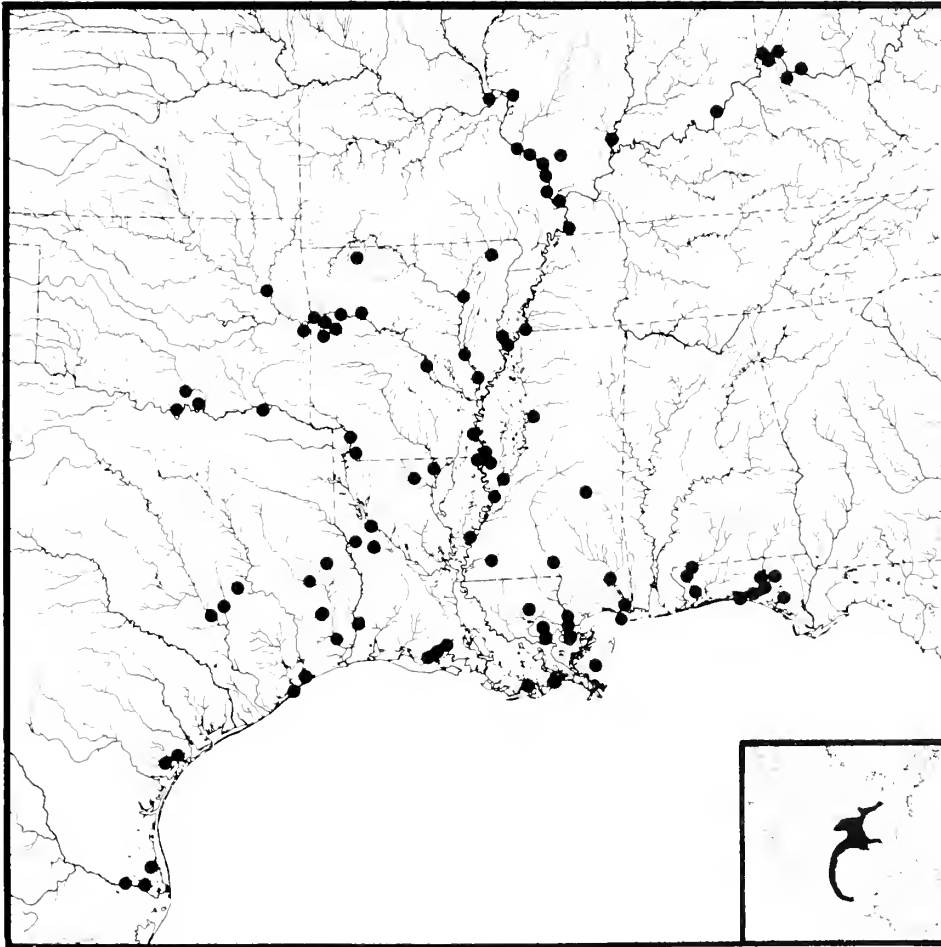
Order Lepisosteiformes
Family Lepisosteidae

TYPE LOCALITY: None given (Lacepede 1803. *Histoire Naturelle des Poissons* 5:1-803).

SYSTEMATICS: Previously placed in *Lepisosteus* by Suttkus (1963. Order Lepisosteiformes in Mem. Sears Found. Mar. Res. 1[3]:61-88). Placed by Wiley (1976. Univ. Kans. Mus. Nat. Hist. Misc. Publ. 64:1-111) in the genus *Atractosteus* along with *A. tristoechus*, *A. tropicus*, and a number of fossil species. Suttkus (1963) provided a key, synonymy, and descriptive comments. Wiley (1976) provided additional systematic data and phylogenetic affinities. Most closely related to *A. tristoechus* (Wiley 1976).



ca. 169 cm SL (Wiley in Fisher [ed.] 1978. FAO Species identification sheets, Central Western Atlantic, Vol. 3).



DISTRIBUTION AND HABITAT: Econfinia River, FL, west along the Gulf Coastal Plain to Veracruz, Mexico, and north to the lower reaches of the Ohio and Missouri rivers in the Mississippi River drainage (Suttkus 1963; Wiley 1976). A disjunct population has been reported from the Rio Sapoia and Lake Nicaragua (Wiley 1976). An inhabitant of large rivers, bays, and coastal marine waters (Suttkus 1963; Wiley in Fischer 1978. (ed.), *FAO Species Identification Sheets, Central Western Atlantic*, Vol. 3).

ADULT SIZE: 1650 mm - 2960 mm TL, maximum to 3048 mm TL.

BIOLOGY: Spawns in LA from April to June (Suttkus 1963) and in OK in the first half of May (May and Echelle 1968. *Copeia*:629-30). Feeds mostly on fishes and crabs (Suttkus 1963), but also on birds (Raney 1942. *Copeia*: 50) and refuse (Goodyear 1967. *Trans. Am. Fish. Soc.* 92:297-300).

Compilers: D. S. Lee and E. O. Wiley. May 1979.

Lepisosteus oculatus Winchell
Spotted gar

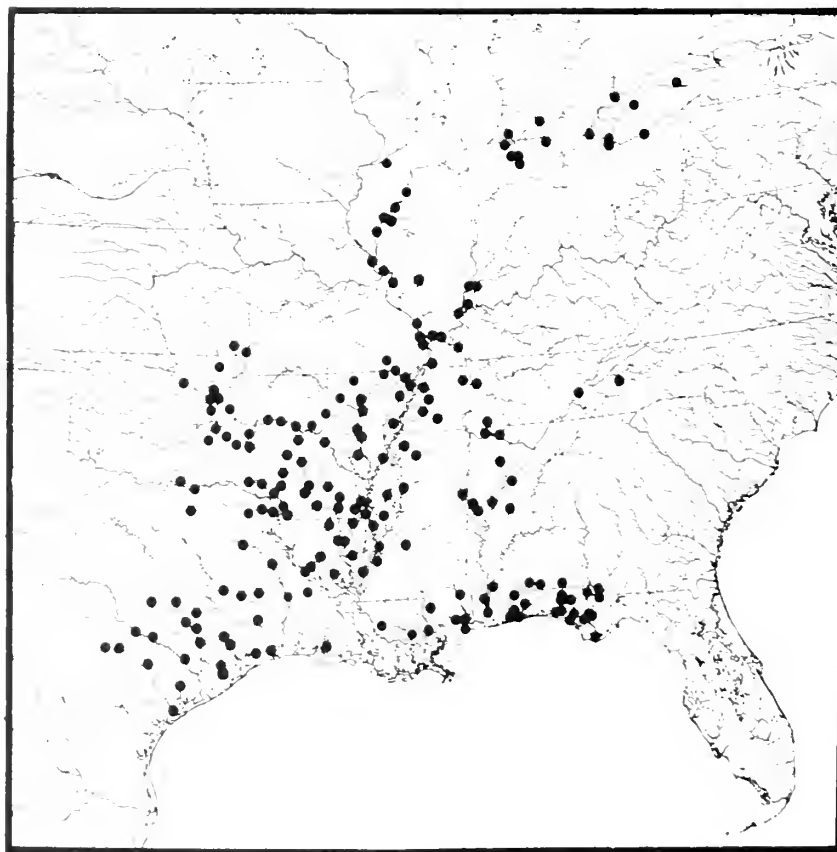
Order Lepisosteiformes
Family Lepisosteidae

TYPE LOCALITY: Duck Lake, Calhoun Co., MI (Winchell 1864. Proc. Acad. Nat. Sci. Phila. 16:183-85).

SYSTEMATICS: Suttkus (1963. Order Lepisostei in Mem. Sears Found. Mar. Res. 1 [3]:61-88) provided a key, synonymy, and descriptive commentary. Wiley (1976. Univ. Kans. Mus. Nat. Hist. Misc. Pap. 64:1-111) provided additional systematic data and phylogenetic relationships, and arranged the gars into two genera (*Lepisosteus* and *Atractosteus*). Most closely related to *L. platyrhincus* (Suttkus 1963; Wiley 1976).



ca. 85 cm SL (Wiley in Fisher [ed.] 1978).



DISTRIBUTION AND HABITAT: Great Lakes south to Gulf Coast, east to western FL (where occurs and probably hybridizes with *L. platyrhincus* in lower Apalachicola River), north to Lake Erie drainage of OH and MI, west to central TX (Suttkus 1963). Most abundant in quiet, clear water with much aquatic vegetation. Enters brackish water along Gulf Coast (Suttkus 1963; Wiley in Fisher [ed.] 1978. *FAO Species Identification Sheets, Central Western Atlantic*, Vol. 3).

ADULT SIZE: ca. 91 cm TL.

BIOLOGY: Growth data, spawning, and food habits summarized in Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1). Spawns in spring in shallow water among rooted aquatic vegetation. Mainly piscivorous, but many take crabs when available (Lambou 1961. Prog. Fish Cult. 23:18-25; Suttkus 1963). Life history and ecology of the species in southeastern MO studied by Redmond (1964. M.A.thesis, Univ. Maryland).

Compilers: D. S. Lee and E. O. Wiley, May 1979.

Lepisosteus osseus Linnaeus
Longnose gar

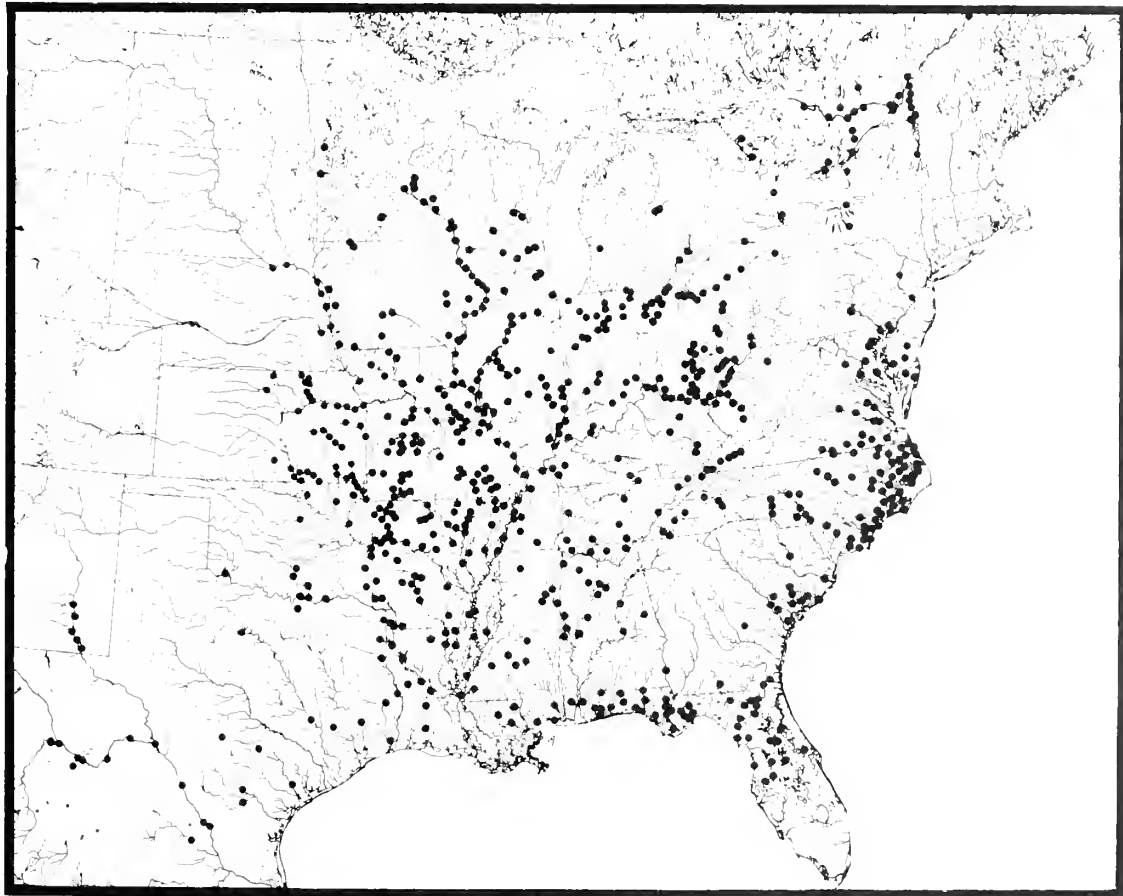
Order Lepisosteiformes
Family Lepisosteidae

TYPE LOCALITY: "Virginia" (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Suttkus (1963. Order Lepisosteii in Mem. Sears Found. Mar. Res. 1 [3]:61-88) provided key for identification, synonymy, and description of species. Wiley (1976. Univ. Kans. Mus. Nat. Hist. Misc. Publ. 64:1-111) provided additional systematic data, and placed gars into two genera (*Lepisosteus* and *Atractosteus*). *Lepisosteus osseus* is closest Recent relative of *L. oculatus-platyrrhincus* species pair (Wiley 1976).



MD: Dorchester Co.,
Marshyhope Creek, 36 cm TL
(NCSM).



DISTRIBUTION AND HABITAT: Southern QU south to FL, west to Great Lakes region and southwest to middle Rio Grande of Mexico and middle Rio Pecos drainage of NM (Suttkus 1963; Wiley in Fisher [ed.] 1978. FAO Species Identification Sheets). In fresh and brackish waters of larger streams and coastal inlets throughout range. Occasionally in marine coastal waters.

ADULT SIZE: Common to 150 cm TL, probably exceeds 200 cm TL.

BIOLOGY: Growth data, and spawning and food habits summarized by Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1). Males mature at three to four years, females at six years. Breeding may occur between March and August, depending on geographic location, in freshwater. Young to 50 mm TL eat invertebrates. Larger individuals mainly piscivorous, but Suttkus (1963) reported that brackish-water individuals also eat crabs.

Compiler: E. O. Wiley. May 1979.

Lepisosteus platostomus Rafinesque
Shortnose gar

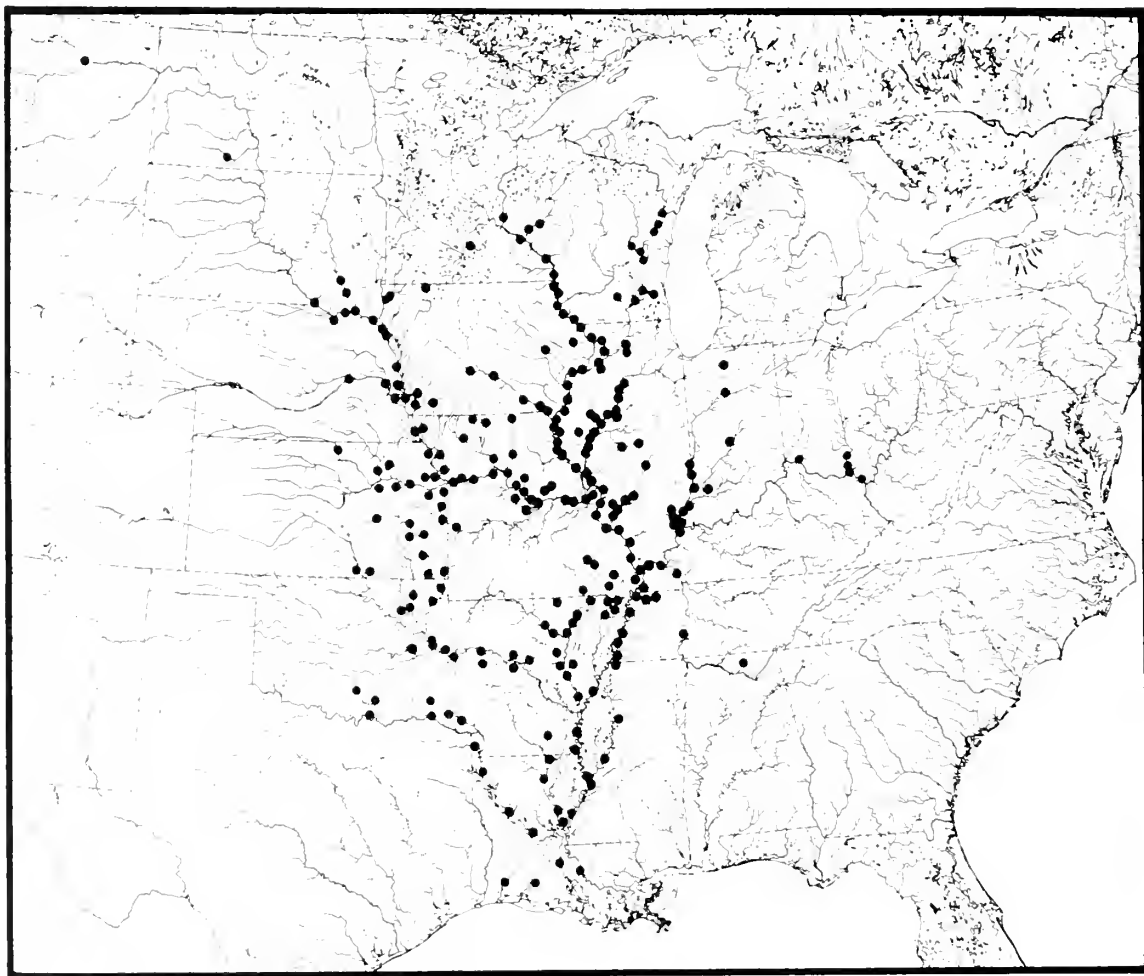
Order Lepisosteiformes
Family Lepisosteidae

TYPE LOCALITY: Ohio River (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Suttkus (1963. Order Lepisosteiformes in Mem. Sears Found. Mar. Res. 1[3]:61-88) included species in taxonomic key. Wiley (1976. Univ. Kans. Mus. Nat. Hist. Misc. Publ. 64:1-111) discussed systematics, synonymy, fossil history, and retention in genus *Lepisosteus*.



MO: Boone Co., Missouri River
at Rocheport (Mo. Dept. Cons).



DISTRIBUTION AND HABITAT: Essentially limited to low gradient portions of Mississippi basin. Absent from Ozark plateau. Common in quiet, unvegetated, often backwater areas of river, and in lakes and oxbows. More tolerant of turbidity than most gars.

ADULT SIZE: 450-800 mm TL.

BIOLOGY: Spawns in water 19-24°C from May to early July in northern part of range (Richardson 1913. Bull. Ill. State Lab. Nat. Hist. 9:387-404; Potter 1926. Univ. Ia. Stud. Nat. Hist. 11:17-27; Shields 1958. S.D. Dept.

Game Fish Parks-Dingell-Johnson Proj., F-1-R-7: 1-48). Grows rapidly and reaches sexual maturity at three years. Have survived 20 years in captivity (Flower 1925. Proc. Zool. Soc. Lond.: 247-68). Feeds mostly in morning, on crayfish and fish (Potter 1923. Proc. La. Acad. Sci. 30:167-70) and emerging aquatic insects. Summary of life history and age and growth data available in Pflieger (1975. *The Fishes of Missouri*) and Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1).

Compiler: D.S. Lee, September 1978.

Lepisosteus platyrhincus DeKay
Florida gar

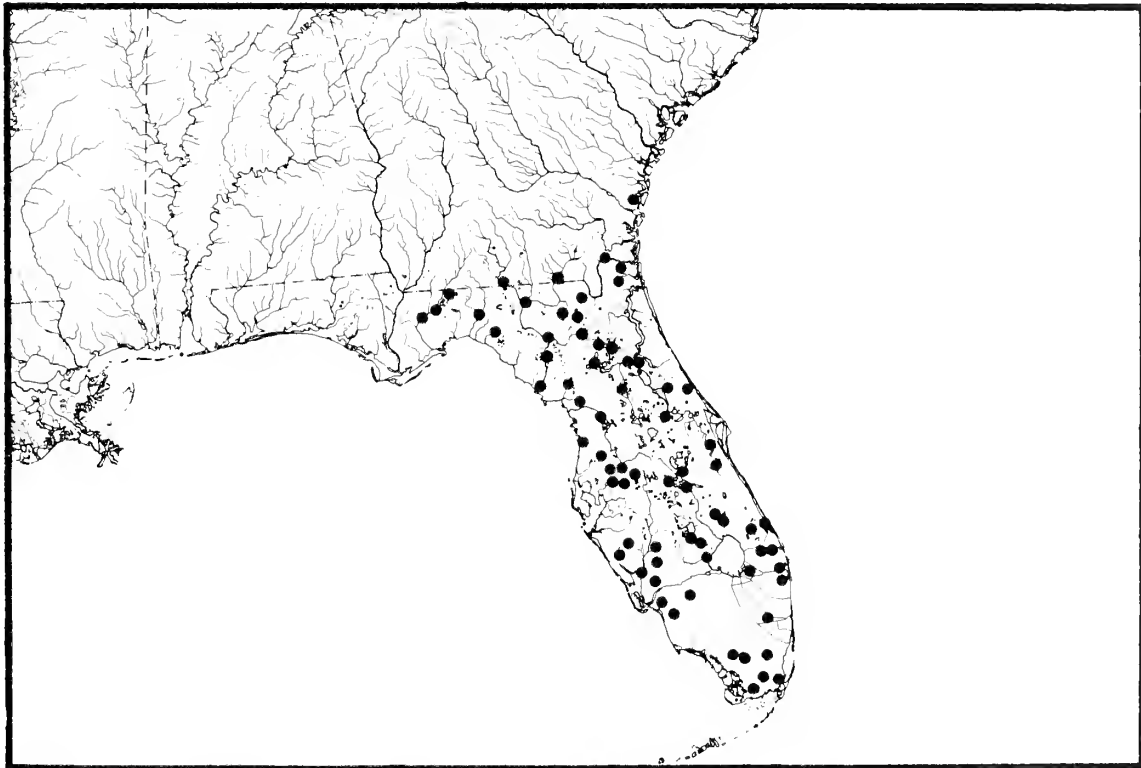
Order Semionotiformes
Family Lepisosteidae

TYPE LOCALITY: "Florida" (DeKay 1842. Natural History of New York, I. Zoology, 4. Fishes).

SYSTEMATICS: Suttkus (1963. Order Lepisostei in Mem. Sears Found. Mar. Res. 1[3]:61-88) redescribed species and provided key to living forms of genus. Wiley (1976. Misc. Publ. Univ. Kans. Mus. Nat. Hist. 64: 1-111) described species and discussed relationships of fossil and living species. Most closely related to *L. oculatus*, with which may hybridize in lower Apalachicola River drainage (R. D. Suttkus, pers. comm.).



(NCSM)



DISTRIBUTION AND HABITAT: Ocklockonee River drainage, FL and GA, south through peninsular FL and north to Savannah River drainage, GA (Dahlberg and Scott 1971. Bull. Ga. Acad. Sci. 29: 1-64). Evidence of possible gene interchange with *L. oculatus* in adjacent Apalachicola River drainage to west. In moderate to large, quiet lowland streams and lakes having mud-sand bottom and, frequently, heavy submergent aquatic vegetation. Usually relatively common.

ADULT SIZE: 330-860 mm TL; maximum size 1331 mm TL.

BIOLOGY: Feeds primarily on fish, but various crustaceans and insects also eaten (Hunt 1953. Trans. Am. Fish Soc. 82: 13-33; Holloway 1954. J. Wildl. Manage. 18: 438-49). Spawns mostly in April and May, but spawning may continue into October (Moody 1957. Q. J. Fla. Acad. Sci. 20: 21-88).

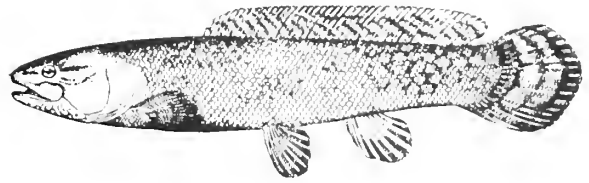
Compiler: C. R. Gilbert. April 1979.

Amia calva Linnaeus
Bowfin

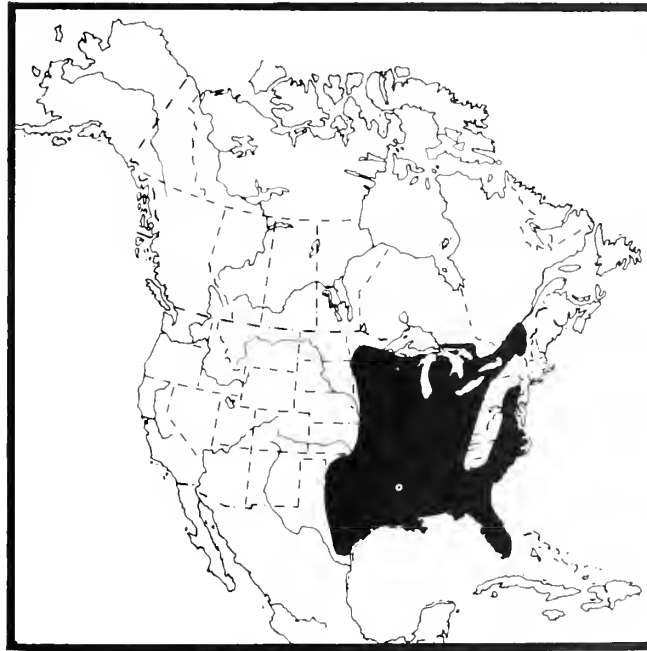
Order Amiiformes
Family Amiidae

TYPE LOCALITY: Charleston, SC (Linnaeus 1766. *Systema naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532).

SYSTEMATICS: Sole living representative of Amiiformes, which first appeared in Triassic and was well developed in middle Mesozoic (Bailey 1971. McGraw-Hill Encycl. Sci. Technol., 3 ed: 339-40). Genus *Amia* extends back into Upper Cretaceous, and occurs in early Tertiary in North America (Patterson in Greenwood et al. (eds.) 1973. *Interrelationships of Fishes*).



Female (Jordan and Evermann 1900).



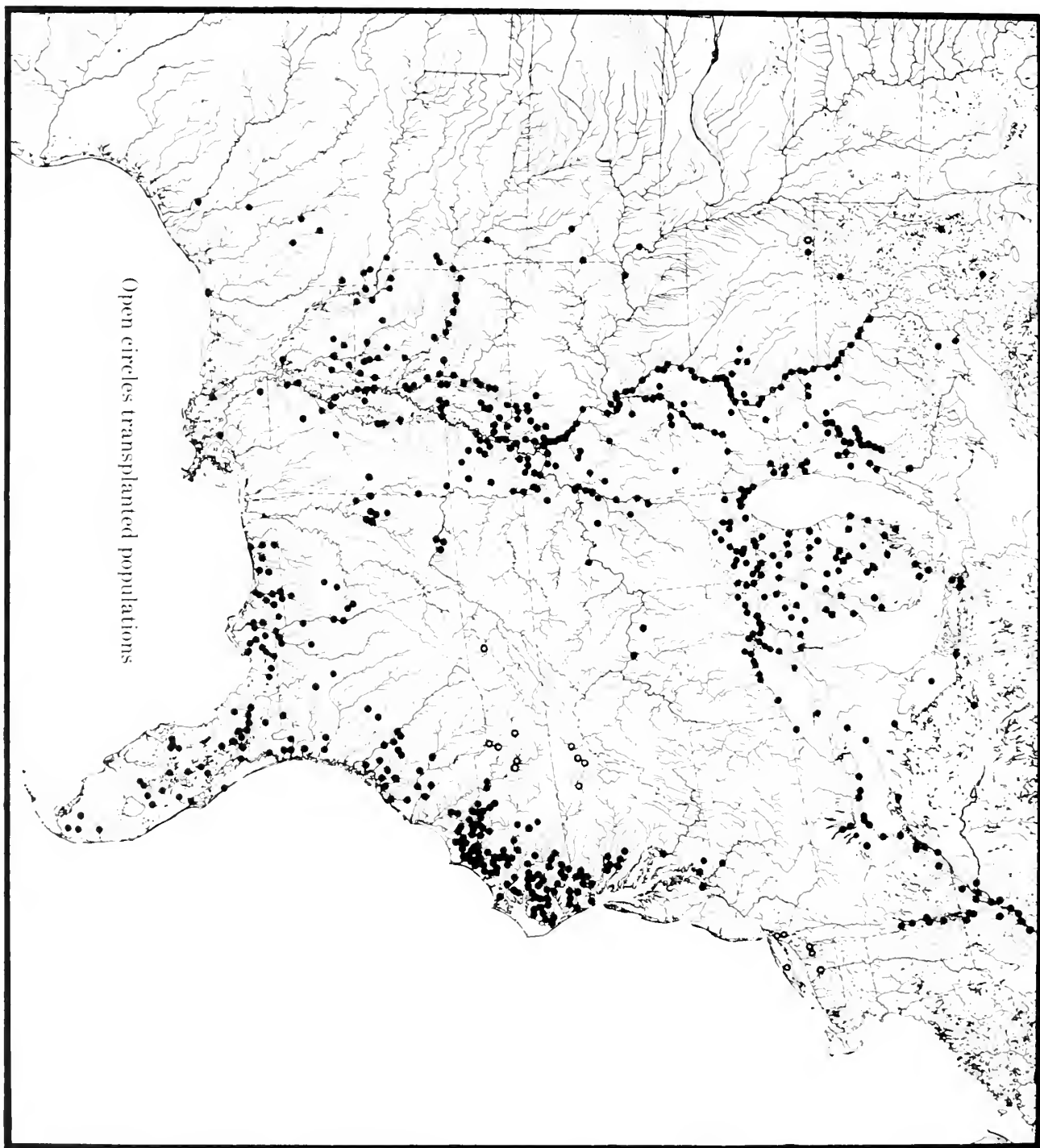
See map on next page

DISTRIBUTION AND HABITAT: Known from St. Lawrence and Ottawa rivers and Lake Champlain west throughout Great Lakes, including Georgian Bay and lakes Nipissing and Simcoe, ON; south in Mississippi basin from Lake Winnibigoshish, MN, to LA; in lower TX drainages west to Colorado River; and along Coastal Plain from AL to eastern PA. Changes in environmental quality have probably all but eliminated it from Missouri system, where it was historically known as far north as eastern SD (Churchill and Over 1933. *Fishes of South Dakota*). Pflieger (1975. *Fishes of Missouri*) stated that all Missouri River records may be attributable to introduction, a view not subscribed to here. Introduced in a number of localities in IA, IL, NC, and CT. Inhabitant of sluggish, clear, often vegetated, lowland waters.

ADULT SIZE: 457-610 mm TL, 870 mm TL maximum.

BIOLOGY: Commonly used as laboratory test animal because of status as a "living fossil", ease of maintenance, and interesting behavioral and physiological attributes. Capable of gulping air at the surface and can withstand high temperatures, and is even known to aestivate (Neill 1950. *Copeia*: 240). Males build circular nests in shallow, vegetated areas in the spring, and protect schooling young after hatching. Mansueti and Hardy (1967. *Development of Fishes of the Chesapeake Bay Region*) described early development. Voracious predator that favors fish but will consume virtually any type of animal. Hoffman (1967. *Parasites of North American Freshwater Fishes*) listed parasites. May live at least 30 years (Carlander 1969. *Handbook of Freshwater Fishery Biology* Vol. 1). Biology summarized in Scott and Crossman (1973. *Freshwater Fishes of Canada*) and Pflieger (1975).

Compilers: G. H. Burgess and C. R. Gilbert. November 1978.



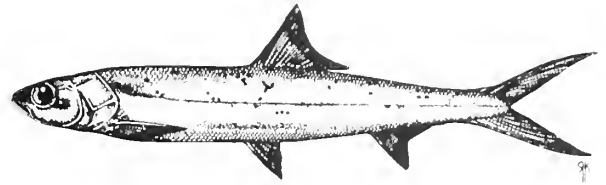
Distribution of bowfin, *Amia calva*

Elops affinis Regan
Machete

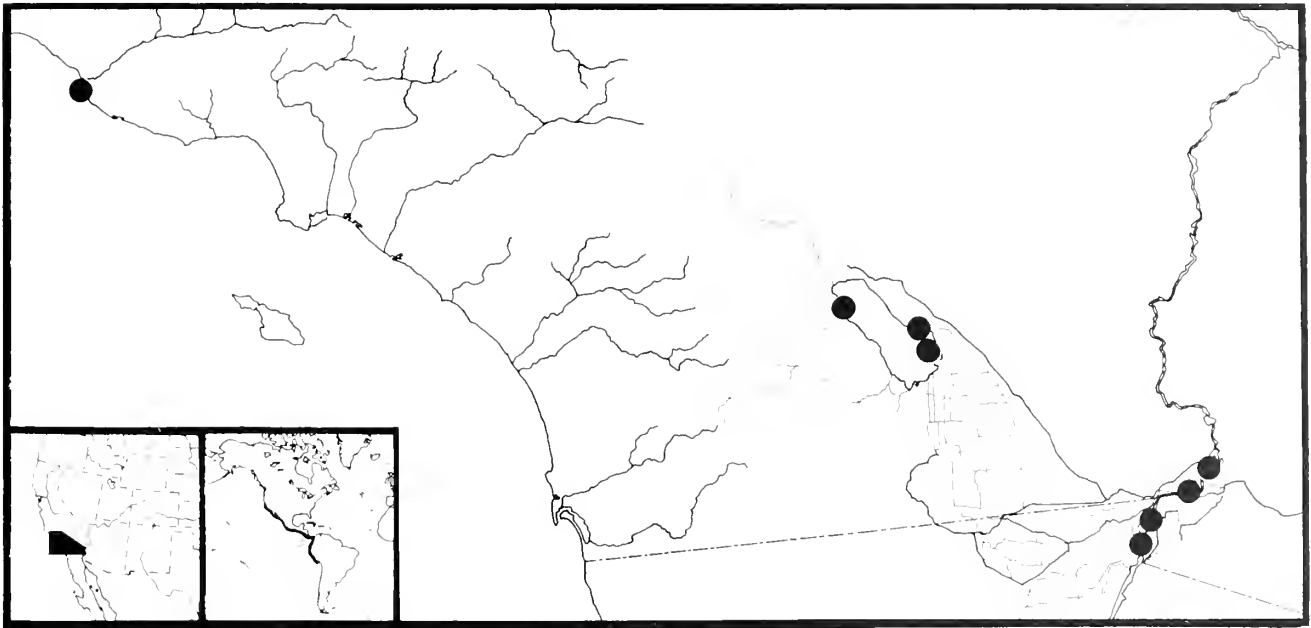
Order Elopiformes
Family Elopidae

TYPE LOCALITY: Mazatlan and Jalisco, Pacific Coast of Mexico (Regan 1909, Ann. Mag. Nat. Hist. Lond. [Ser. 8] 3:37-40).

SYSTEMATICS: One of about seven species, mostly allopatric, in this worldwide family. Specific status of the species not well documented, but Nybelin (1979, Acta Regiae Soc. Sci. Litt. Gothoburgensis, Zool. 12: 1-37) recognized two subgenera, one monotypic, *Allocllops* with *E. lacerta* as the type, and *Elops*, with *E. saurus* as the type, to contain the remaining species. Forey (1973, Bull. Br. Mus. [Nat. Hist.] Geol. Suppl. 10) doubted the validity of some of the species recognized by Regan (1909) based on the conclusions of Whitehead (1962, Ann. Mag. Nat. Hist. Lond. [Ser. 13] 5:321-29).



(NCSM)



DISTRIBUTION AND HABITAT: Eastern Pacific Ocean, Peru to north Ventura Co., CA (Miller and Lea 1976, Calif. Fish Game Bull. 157:239). Lower Colorado River drainage AZ to CA, and formerly in Salton Sea, CA (Minckley 1973, *Fishes of Arizona*; Walker et al. 1961, Calif. Fish Game Fish Bull. 113:77-78). Enters fresh water in United States only in Colorado River, AZ and CA, and should not penetrate upstream beyond Imperial Dam. Not recorded since 1943 in the Colorado River and Salton Sea (Dill 1944, Calif. Fish Game 30:109-211).

ADULT SIZE: 300-500 mm SL and to about 1.35 kg.

BIOLOGY: Not as commonly encountered or as well known as western Atlantic *E. saurus*. In marine waters is a crepuscular predator around shallow reefs (Thomson et al. 1979, *Reef Fishes of the Gulf of California*). Colorado River and Salton Sea populations eat *Cyprinodon macularius* and a hydrophilid beetle and range from 203-500 mm (Dill 1944). Many of these fish were reported to be gravid but no evidence of successful reproduction was found. Known to penetrate fresh water farther south in Mexico (Castro-Aguirre 1978, Dirr, Gen. Inst. nac. Pesca. Ser. Cient. 19:1-298). Otherwise life history presumed to be similar to *E. saurus* (Minckley 1973).

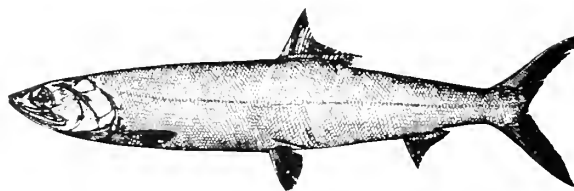
Compiler: C. C. Swift, December 1979.

Elops saurus Linnaeus
Ladyfish

Order Elopiformes
Family Elopidae

TYPE LOCALITY: "Carolina" (Linnaeus 1766. *Systema naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532).

SYSTEMATICS: Whitehead (1962. *Ann. Mag. Nat. Hist.* [Ser. 13] 5:321-29) revised genus and recognized six species, but others have suggested possibility of single cosmopolitan species. Considered closely related to *E. affinis* of Pacific coast by Hildebrand (1963. *Family Elopidae in Mem. Sears. Found. Mar. Res.* 1[3]:111-31), who found no geographic variation in numbers of gill rakers.



ca. 38 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Western Atlantic from Cape Cod to Rio de Janeiro, Brazil, including Gulf of Mexico and Caribbean region; most common from NC south. Also recorded from Red Sea and Indian and western Pacific oceans. Typically in shallow salt and brackish lagoons and ponds, but occasionally encountered several miles offshore. Not uncommon in fresh waters of St. Johns River, FL (McLane 1955. Ph.D. diss., Univ. Florida; Tagatz 1968. *Q. J. Fla. Acad. Sci.* 30:25-50), where it prefers open water areas in channels with moderate current, and shallow bars and eddies at bends in river (McLane 1955). Abundance varies with locality and season.

ADULT SIZE: Normally under 500 mm TL, 900 mm TL maximum.

BIOLOGY: Hildebrand (1963) summarized early literature regarding development,

spawning, food, parasites, and ecology. Spawns offshore throughout year (Eldred and Lyons 1966. *Fla. Board Conserv. Mar. Lab. Leaflet*, Ser. 4 [2]:1-6); leptocephalus larvae move into coastal waters and transform (Gehringer 1959. *U.S. Fish Wildl. Ser. Fish. Bull.* 59:619-47). Early development summarized by Jones et al. (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 1). Feeds primarily on fishes, less so on shrimps (McLane 1955; Sekavec 1974. *Trans. Am. Fish. Soc.* 103:472-76). Sekavec (1971. *Chesapeake Sci.* 12:275-76) described gut morphology. McLane (1955) and Sekavec (1974) presented length-weight data, and Merriman (1939. *Copeia*: 2:113-14) described scales. Often schools. Popular game fish.

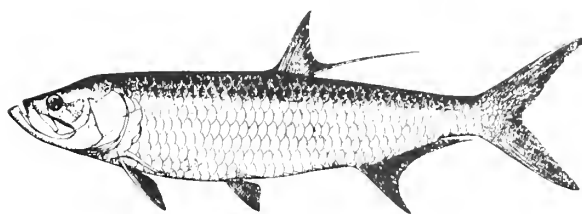
Compilers: G. H. Burgess and D. S. Lee. June 1979.

Megalops atlanticus Valenciennes
Tarpon

Order Elopiformes
Family Elopidae

TYPE LOCALITY: Guadeloupe, Santo Domingo, Martinique, Puerto Rico (Valenciennes in Cuvier and Valenciennes 1846. *Histoire Naturelle des Poissons* 19).

SYSTEMATICS: Two extant species in family: *M. atlanticus* (Atlantic) and *M. cyprinoides* (Indo-Pacific). Greenwood (1970. Bull. Br. Mus. Nat. Hist. [Zool.] 19:121-35) placed *M. atlanticus* in genus *Tarpon*, as did Hildebrand (1963. Family Elopidae in Sears Found. Mar. Res. Mem. 1 [3]: 111-31) and Nelson (1976. *Fishes of the World*).



ca. 36 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Nova Scotia to Brazil, including Bermuda, Bahamas, and Caribbean islands; sporadic as summer waifs north of SC. Also along African west coast. Juveniles (< 280 mm SL) frequent still and flowing dark waters in brackish (0-22.3 ppt.) marsh pools and creeks (Rickards 1968. Bull. Mar. Sci. 18:220-39); larger young (300-450 mm SL) inhabit headwaters of brackish and fresh-water streams, while adults found in more open, saline situations (Hildebrand 1963).

ADULT SIZE: 122-183 cm TL, 245 cm TL maximum.

BIOLOGY: Spawns offshore, leptocephalus larvae move into coastal waters and metamorphose into juveniles (Wade 1962. Bull. Mar. Sci. Gulf Carib. 12:545-622). Early

development described by Harrington (1958. Copeia: 1-10) and Wade (1962), summarized in Jones et al. (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 1). Juveniles eat fishes, copepods, ostracods, shrimps and insects (especially mosquitoes); adults almost exclusively piscivorous (Breder 1944. Zoologica 29:217-52; Harrington and Harrington 1960. Copeia: 311-19; Rickards 1968). Length/weight relationships presented by Breder (1944) and Rickards (1968). Obligate air breather (Schlaifer 1941. Zoologica 26:55-60). Parasites reviewed by Wade (1962). Juveniles preyed on by birds, adults by sharks and porpoises (Wade 1962; Rickards 1968). Does not school, but may form loose feeding aggregations. Renowned game fish with great leaping ability.

Compiler: G. H. Burgess. June 1979.

***Anguilla rostrata* (Lesueur)**
American eel

Order Anguilliformes
Family Anguillidae

TYPE LOCALITY: Cayuga Lake, NY (Lesueur 1817. J. Acad. Nat. Sci. Phila. 1:81-83).

SYSTEMATICS: Of 16 species of *Anguilla*, only *A. rostrata* occurs in North America. *Anguilla rostrata* similar in appearance to European eel, *A. anguilla*, but separated by number of vertebrae (110-119 and 103-111, respectively) (Scott and Crossman 1973. *Freshwater Fishes of Canada*).

DE: Kent Co., McCauley's
Pond, 138 mm TL (NCSM).



See map on next page

DISTRIBUTION AND HABITAT: Principally along Atlantic and Gulf slopes of North America, penetrating tributaries for considerable distances. Known from Greenland, throughout much of West Indies, Caribbean coasts of Central and South America, and occasionally south to Brazil. In North America, occurs inland to Great Lakes, headwaters of many Atlantic and Gulf slope rivers, and in Mississippi Valley as far inland as KS, NB, SD, MN, WI, and PA. Introduced into several inland and west coast areas. Common in most aquatic habitats with access to the sea.

ADULT SIZE: 60-300 mm TL (freshwater)
at least 1200 mm maximum.

BIOLOGY: Catadromous. Adults breed at sea after living most of lives in fresh and brackish waters. Both American and European eels generally thought to breed in Sargasso Sea at depths of 400-500 m, with young of each species dispersing in opposite directions. Vladykov (1964. J. Fish. Res. Board Can. 21: 1523-30), however, suggested spawning grounds may be farther south than previously believed. Females encountered most frequently in fresh water. Length of residence not confirmed, although in NB Smith and Saunders (1955. J. Fish. Res. Board Can. 12:238-269) recognized nine year classes. They noted that diet was 90% larval aquatic insects.

Compiler: D. S. Lee. February 1978.

Distribution of American eel, *Anguilla rostrata*

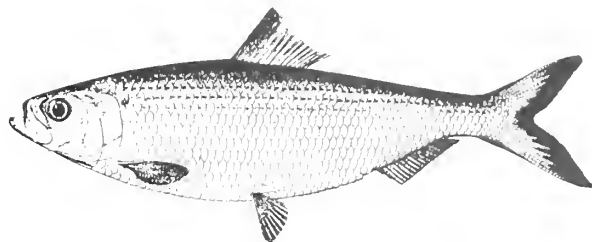


Alosa aestivalis (Mitchill)
Blueback herring

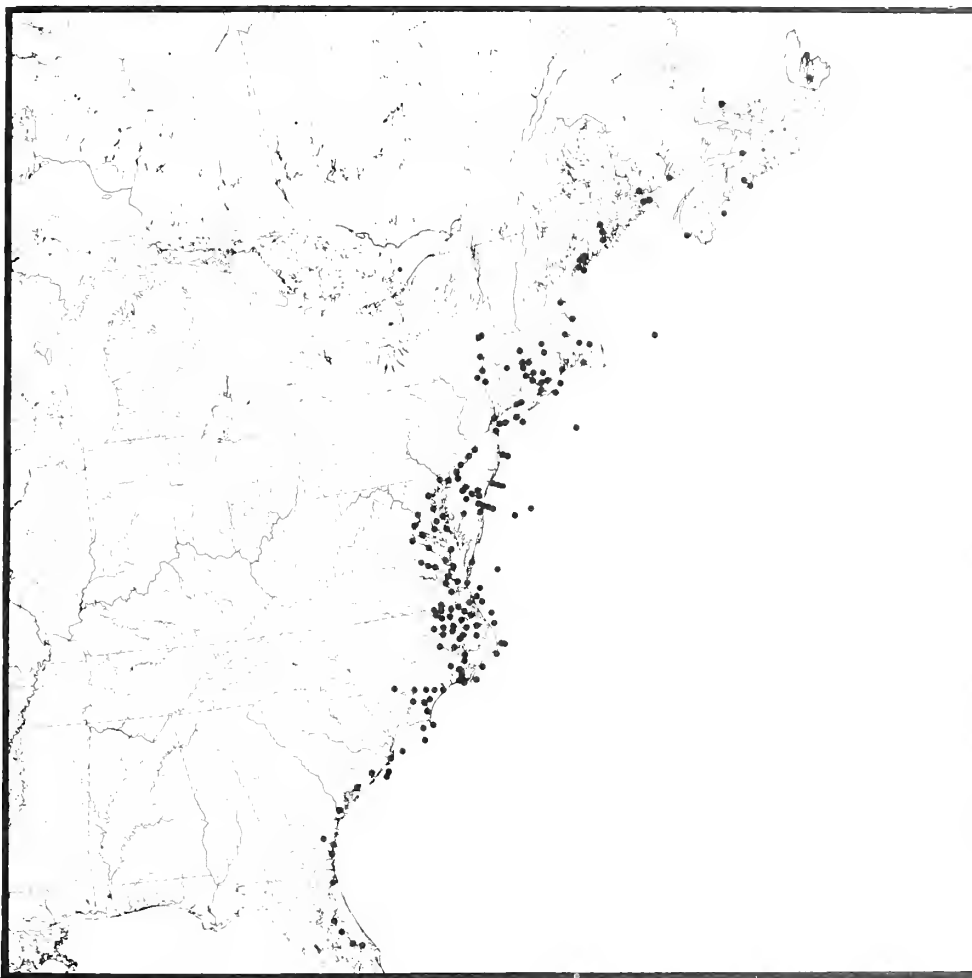
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: New York (Mitchill 1815. Trans. Lit. Philos. Soc. N.Y. 1:355-492).

SYSTEMATICS: Formerly placed in *Pomolobus*, synonymized most recently under *Alosa* by Svetovidov (1964. Copeia: 118-30). Often confused with *A. pseudoharengus*.



Washington, D.C., market: ca. 23 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Anadromous, ascending most coastal rivers from Cape Breton, NS, to St. Johns River, FL, during spring spawning migrations. Young move seaward at about one month of age (30-50 mm) (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Dams have seriously impeded upstream movements, greatly diminishing former freshwater range. Introduced into certain VA reservoirs.

ADULT SIZE: 200-300 mm SL, 380 mm SL maximum.

BIOLOGY: More selective in choosing spawning sites than *A. pseudoharengus*, opting for areas of deep, swift water over hard substrate (Loesch and Lund 1977. Trans.

Am. Fish. Soc. 106:583-89). Loesch and Lund (1977) also noted sex ratios, ova production, spawning behavior, and age structure in CT, where fish spawned at temperatures of 14-27°C over an extended season. Most spawn by fourth year (Marcy 1969. Trans. Am. Fish. Soc. 98:622-30), and some live to at least eight years (Netzel and Stanek 1966. I.C.N.A.F. Res. Bull. 3:106-10). Feeds on zooplankton, small shrimp, and fish (Scott and Crossman 1973). Early development summarized in Lippson and Moran (1974. *Manual for Identification of Early Developmental Stages of Fishes of the Potomac River Estuary*).

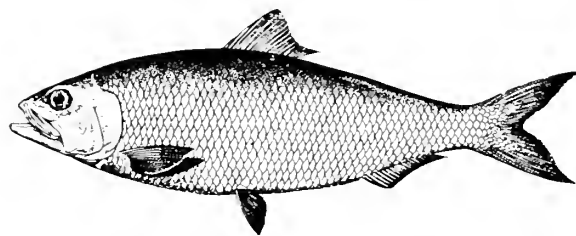
Compiler: G. H. Burgess. September 1978.

Alosa alabamae Jordan and Evermann
Alabama shad

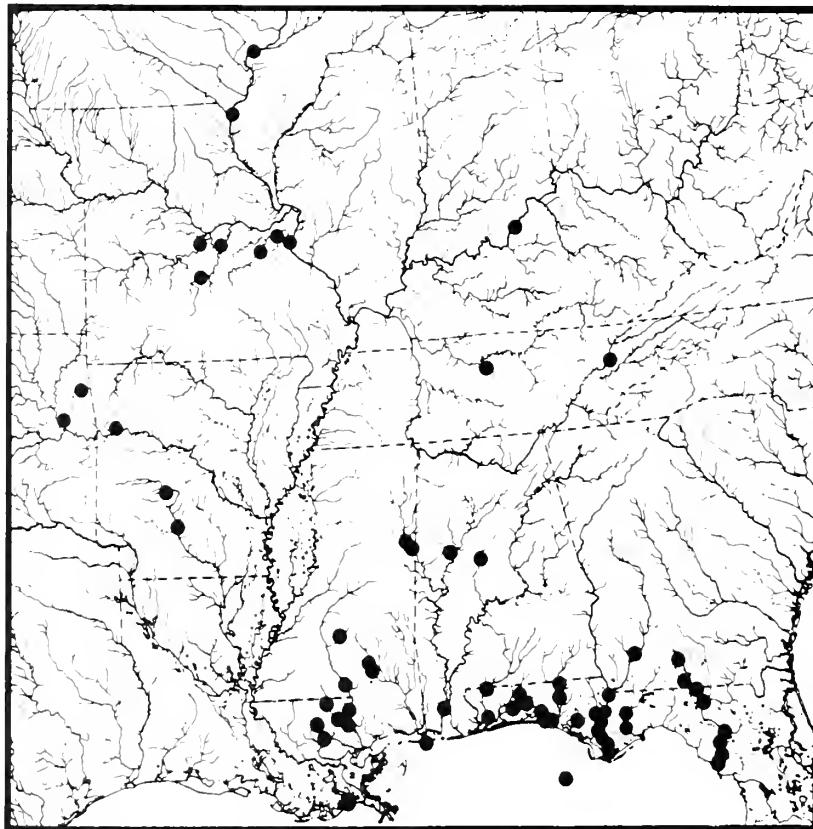
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: Black Warrior River at Tuscaloosa, Tuscaloosa Co., AL (Jordan and Evermann in Evermann 1896. Rept. U.S. Fish. Comm. 21:203-05).

SYSTEMATICS: Forms geographically disjunct species pair with *A. sapidissima* (Berry 1964. Copeia:720-30). *Alosa ohiensis* (Evermann 1902. Rept. U.S. Fish. Comm. 27:273-88) considered a synonym (Hildebrand 1963. Family Clupeidae in Mem. Sears Found. Mar. Res. 1[3]:257-454).



AL: Black Warrior River, Tuscaloosa, male, ca. 32 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Anadromous; ascends major Gulf coast rivers from Suwannee west to Mississippi. Unlike *A. sapidissima*, *A. alabamae* populations are small, and coastal distribution limited. Formerly ascended Mississippi River and many of its major tributaries (Red, Ouachita, Arkansas, Missouri, Ohio, and Tennessee rivers) for considerable distances, but now rare in this basin, possibly a result of locks and increased siltation. Although precise locality records not available it is known from Coosa and Alabama rivers, AL (Hildebrand 1963).

ADULT SIZE: 254-401 mm TL (males), 275-449 mm TL (females).

BIOLOGY: Biological studies essentially confined to those of Laurence and Yerger

(1967. Proc. 20th Ann. Conf. Southeast. Assoc. Game Fish. Comm.: 260-73) and Mills (1972. Fla. Mar. Res. Lab. Tech. Ser. 68:1-24.) in Apalachicola River system, FL, from which most of following data taken. Adults arrive in fresh water of the Apalachicola from January to April, and from May to July in upper Mississippi (Coker 1930. Bull. U.S. Bur. Fish. 45:141-225; Pflieger 1975. *The Fishes of Missouri*). Spawns at 19-22°C in moderate current over coarse sand and gravel bottoms. Females contain 40,000-257,655 eggs. Lives at least four years, with juvenile growth 30 mm/month. Adults do not feed while in fresh water. Juveniles eat small fish and aquatic dipterans before emigrating at 125 mm FL, or in December, whichever comes first.

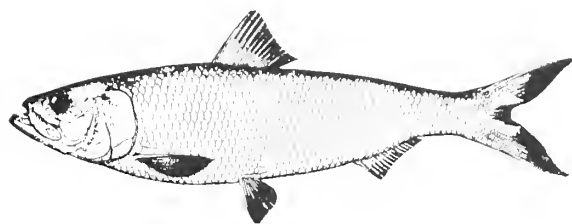
Compiler: G. H. Burgess. October 1978.

Alosa chrysochloris (Rafinesque)
Skipjack herring

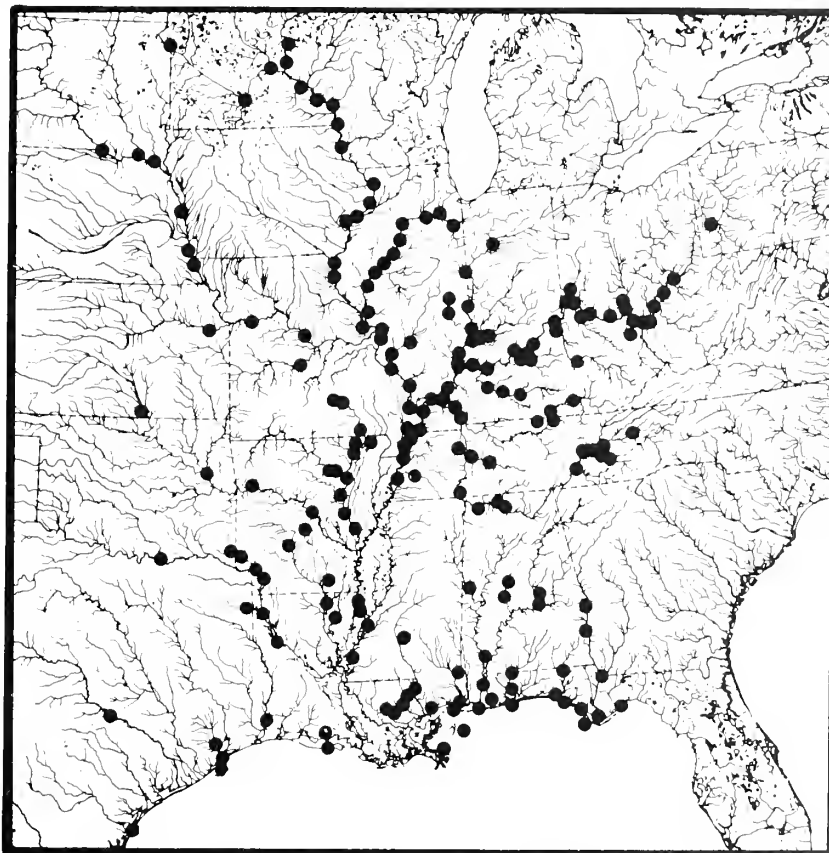
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: "Ohio River" (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Original description may have been based on *A. alabamiae*, or both *A. alabamiae* and *A. chrysochloris* (Hildebrand 1963. Family Clupeidae in Mem. Sears Found. Mar. Res. 1[3]: 257-454). Formerly placed in *Pomolobus*, most recently synonymized with *Alosa* by Svetovidov (1964. Copeia: 118-30). Forms a geographically separated species pair with *A. mediocris* (Berry 1964. Copeia: 720-30).



FL: Pensacola, ca. 27 cm SL
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Highly migratory, peripheral freshwater species that occasionally wanders into brackish and marine waters from FL to TX. In freshwater known from Apalachicola River, FL, west to at least Colorado River, TX. Common in Mississippi River and its larger tributaries, north to MN and SD. Prefers clear, deep waters. Extirpated from upper Mississippi system following construction of navigational facilities there, primarily lock and dam at Keokuk, IA. Found in increasing numbers in Missouri River system in recent years since dredging and impoundments have deepened channel and reduced suspended solids (Cross and Huggins 1975. Copeia: 382-85).

ADULT SIZE: 343-460 mm TL.

BIOLOGY: Wolfe (1969. M.S. thesis, Florida State Univ.) studied species in Apalachicola River, FL; following based on his work, except as otherwise noted. Reproduction occurs over prolonged period: early March to late April in Apalachicola, early May to early July in upper Mississippi (Coker 1930. Bull. U.S. Bur. Fish. 45: 141-225). Spawning probably occurs in the depths of main channel over coarse sand-gravel bars. Females contain 120,973-291,112 ova, with diameters of 0.8-1.0 mm. Both adults and juveniles piscivorous (*Dorosoma* spp. commonly taken); juveniles also eat dipterans and other aquatic insects. Lives at least four years. Length-weight relationship presented by Swingle (1965. Auburn Univ. Agric. Exp. Sta. Zool.-Ent. Ser. Fish. 3: 1-87) and Wolfe (1969).

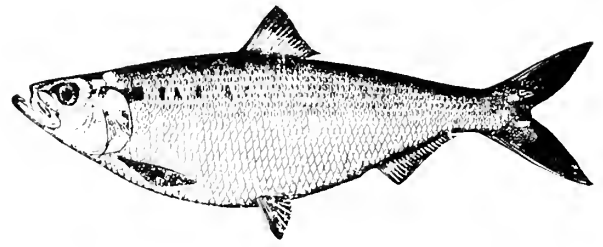
Compiler: G. H. Burgess. October 1978.

Alosa mediocris (Mitchill)
Hickory shad

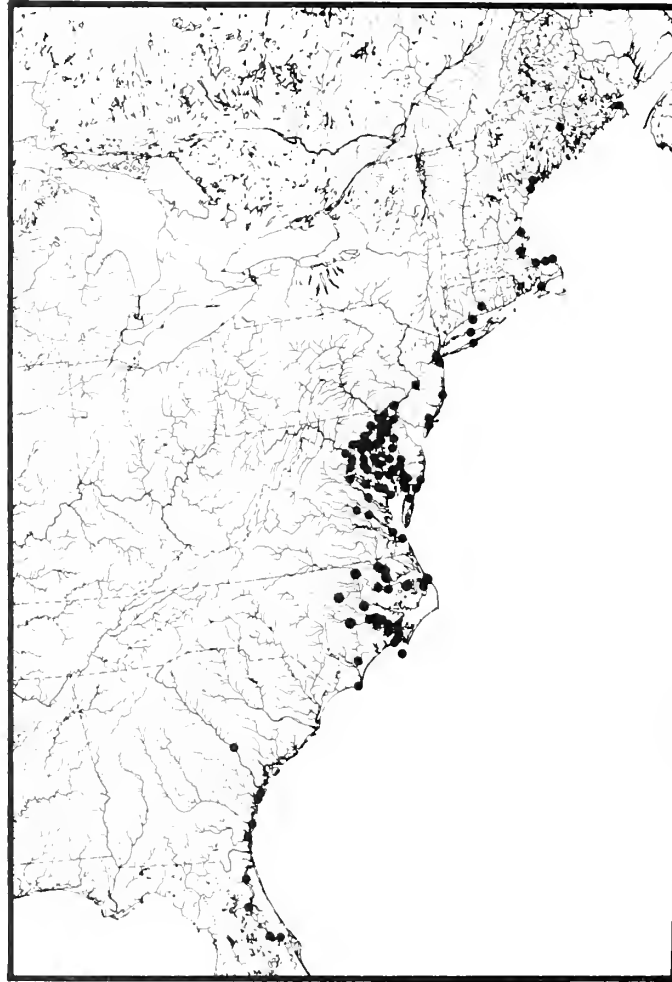
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: "New York" (Mitchill 1815. Trans. Lit. Philos. Soc. N.Y. 1:355-492).

SYSTEMATICS: Formerly placed in *Pomolobus*, most recently synonymized with *Alosa* by Svetovidov (1964. Copeia:118-30). Forms geographically separated species pair with *A. chrysochloris* (Berry 1964. Copeia: 720-30).



SD: White River, near Chamberlain, ca. 19 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Least common east coast *Alosa*. Ranges from Kenduskeag River, ME (Kendall 1914. Proc. Portland Soc. Nat. Hist. 3:1-198), and possibly Campobello Island, NK (Halkett 1913. *Checklist of the Fishes of the Dominion of Canada and Newfoundland*), south to St. Johns River, FL. Center of abundance is Chesapeake Bay and NC. Anadromous; ascends coastal rivers during spring spawning runs.

ADULT SIZE: 287-414 mm TL (males). 320-452 mm TL (females).

BIOLOGY: Mansueti (1962. Chesapeake Sci. 3:173-205) provided only recent biological

treatment. His freshwater collections of eggs and larvae, and successful freshwater hatching of eggs stripped from brood fish, corrected long-standing (Jordan and Evermann 1896. Bull. U.S. Natl. Mus. 47:1-1240) belief that the species was not anadromous. Spawning peaks in early May and ends in early June in Chesapeake Bay. Mansueti (1962) also illustrated eggs, larvae, and early young. Feeds on small fish, squid, fish eggs, and crustaceans (Bigelow and Schroeder 1953. Bull. U.S. Fish Wildl. Serv. 53:1-577). Minor commercial importance, incidentally entering the American shad fishery but has become popular sport fish in recent years.

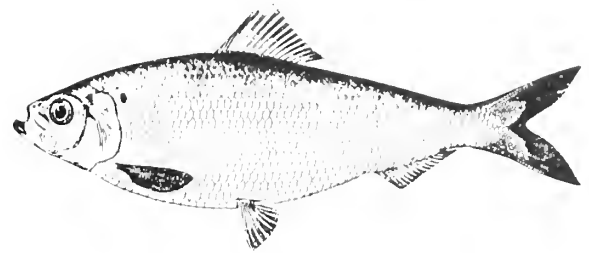
Compiler: G. H. Burgess. December 1978.

Alosa pseudoharengus (Wilson)
Alewife

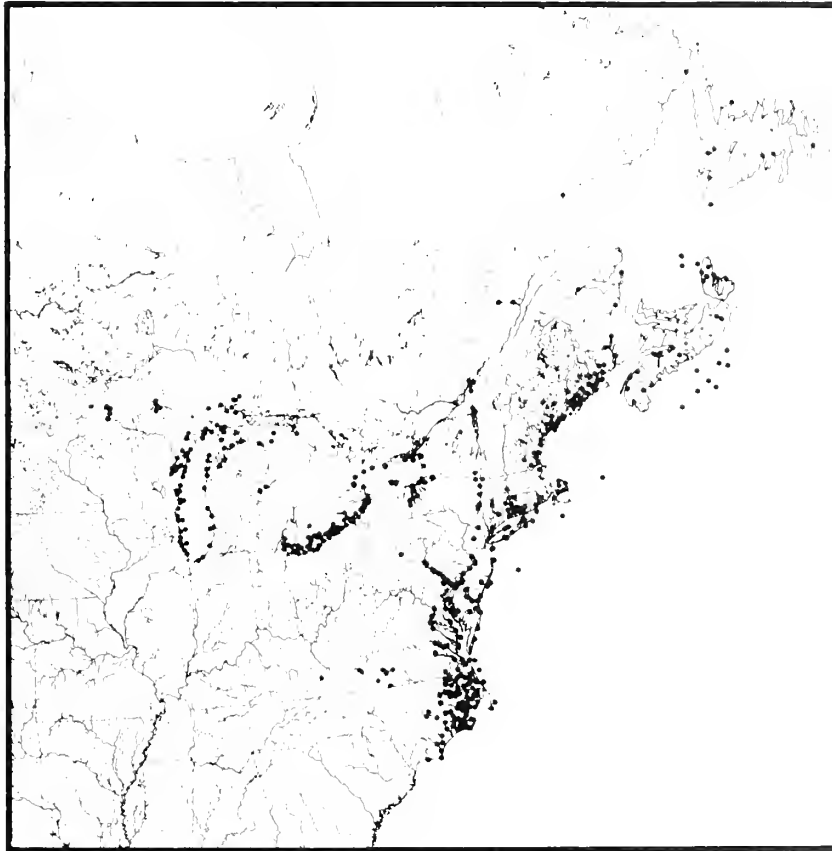
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: Probably Delaware River at Philadelphia, Philadelphia Co., PA (Wilson ca. 1811. in *Rees' New Cyclopedia* 9: no pagination).

SYSTEMATICS: Formerly placed in *Pomolobus*, most recently synonymized with *Alosa* (Svetovidov 1964. *Copeia*:118-30). Often confused with *A. aestivalis*.



Washington, D.C., market: ca. 26 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Anadromous species that ascends most coastal rivers from Red Bay, Labrador, to SC (UMMZ 155234) during spring spawning migrations. Spread throughout Great Lakes after presumptive introduction into Lake Ontario (Miller 1957. *Trans. Am. Fish. Soc.* 86: 97-111). Often excessively abundant in lakes Ontario, Erie, and Michigan, but seems less common in lakes Huron and Superior. Landlocked populations also known in NY, RI, NH, ME, and ON. Dams have seriously impeded upstream movements, greatly diminishing former freshwater range. Introduced to inland reservoirs and appears in some tailwaters in VA.

ADULT SIZE: 250-300 mm SL, 350 mm maximum.

BIOLOGY: Enters rivers earlier in spring than *A. aestivalis*, and spawns in slower moving waters (Kissel 1969. Ph.D. diss., Univ. Connecticut). Feeds primarily on zooplankton and small crustaceans (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Great Lakes populations have increased rapidly in recent years and mass summer die-offs are common. Mansueti and Hardy (1967. *Development of Fishes of the Chesapeake Bay Region*) and Lippson and Moran (1974. *Manual for Identification of Early Developmental Stages of Fishes of the Potomac River Estuary*) summarized early development.

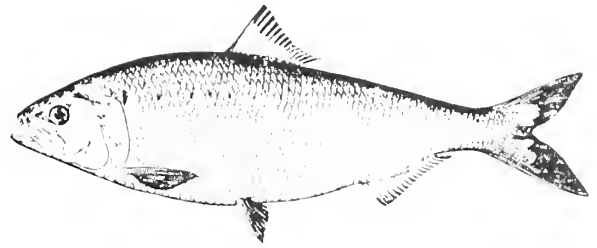
Compiler: G. H. Burgess. July 1978.

Alosa sapidissima (Wilson)
American shad

Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: Probably Delaware River at Philadelphia, Philadelphia Co., PA (Wilson ca. 1811. in *Rees' New Cyclopedia* 9: no pagination).

SYSTEMATICS: Forms geographically disjunct species pair with *A. alabamiae* (Berry 1964. *Copeia*:720-30). Meristic differences seen between spawning populations inhabiting various river systems (and their tributaries) along Atlantic coast (Carscadden and Leggett 1975. *J. Fish. Res. Board Can.* 32:653-60 and included references).



VA: Norfolk, ca. 43 cm SL
(Jordan and Evermann 1900).

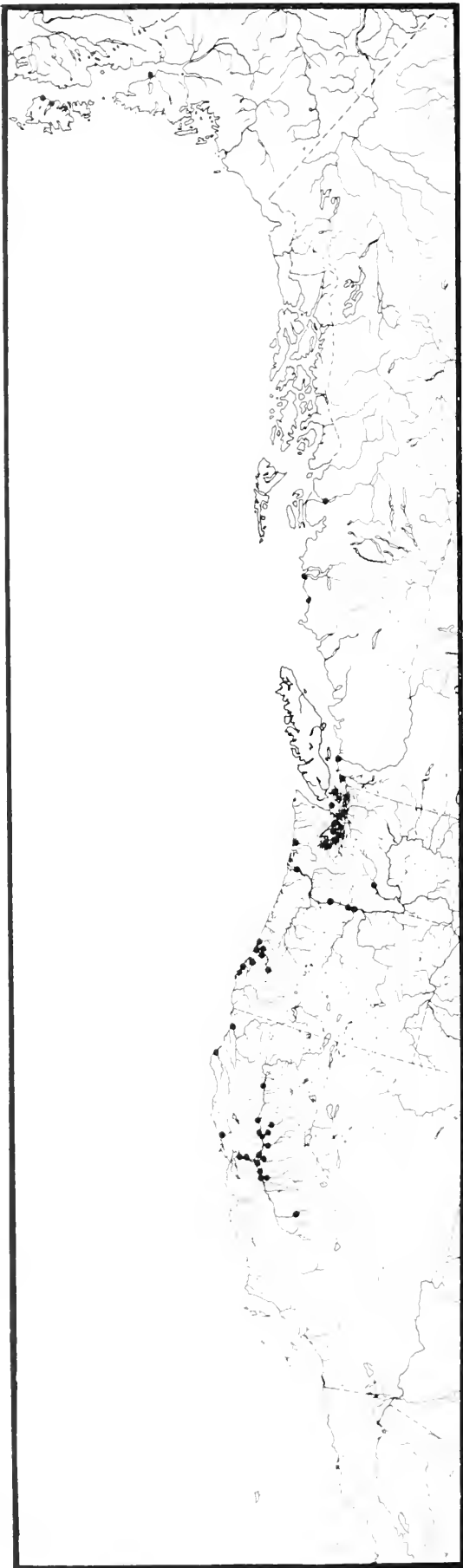


DISTRIBUTION AND HABITAT: Moves (or formerly moved) farther upstream than other anadromous *Alosa* during spring spawning migrations. Dams have curtailed most long distance runs, but some fish still travel over 483 km up St. Johns River, FL. Natural range is Sand Hill River, Labrador, to St. Johns River, FL. Introduced in Sacramento River, CA, 1871-81, and since spread to Todos Santos Bay, Mexico and Kamchatka, USSR. Landlocked in Millerton Lake, CA. **ADULT SIZE:** 250-350 mm SL, 584 mm SL maximum.

BIOLOGY: Supports important sport and commercial fisheries, thus considerable biological data available. Mansueti and Kolb (1953. *Chesapeake Biol. Lab. Publ.* 97:1-293) produced thorough historical review of fisheries, and Leim (1924. *Contrib.*

Can. Biol. n.s.2:163-284) provided much life history information. Scott and Crossman (1973. *Freshwater Fishes of Canada*) and Bigelow and Schroeder (1953. *U.S. Fish Wildl. Serv. Fish. Bull.* 74:1-575) presented excellent syntheses of subsequent works. Leggett and Whitney (1972. *NOAA U.S. Fish. Bull.* 70:659-70) and Carscadden and Leggett (1975) showed that shad are highly specific in returning to natal rivers, migrations correlating with water temperature (13-18°C). Katz (1978. *J. Fish Biol.* 12:609-14) described exogenous circadian rhythm in juveniles. Early development summarized in Lippson and Moran (1974. *Manual for the Identification of Early Developmental Stages of Fishes of the Potomac River Estuary*).

Compiler: G. H. Burgess. September 1978.



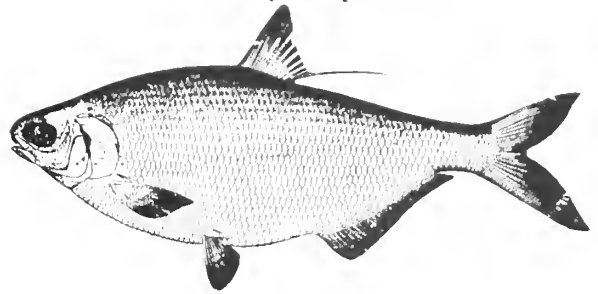
Distribution of American shad, *Alosa sapidissima*

Dorosoma cepedianum (Lesueur)
Gizzard shad

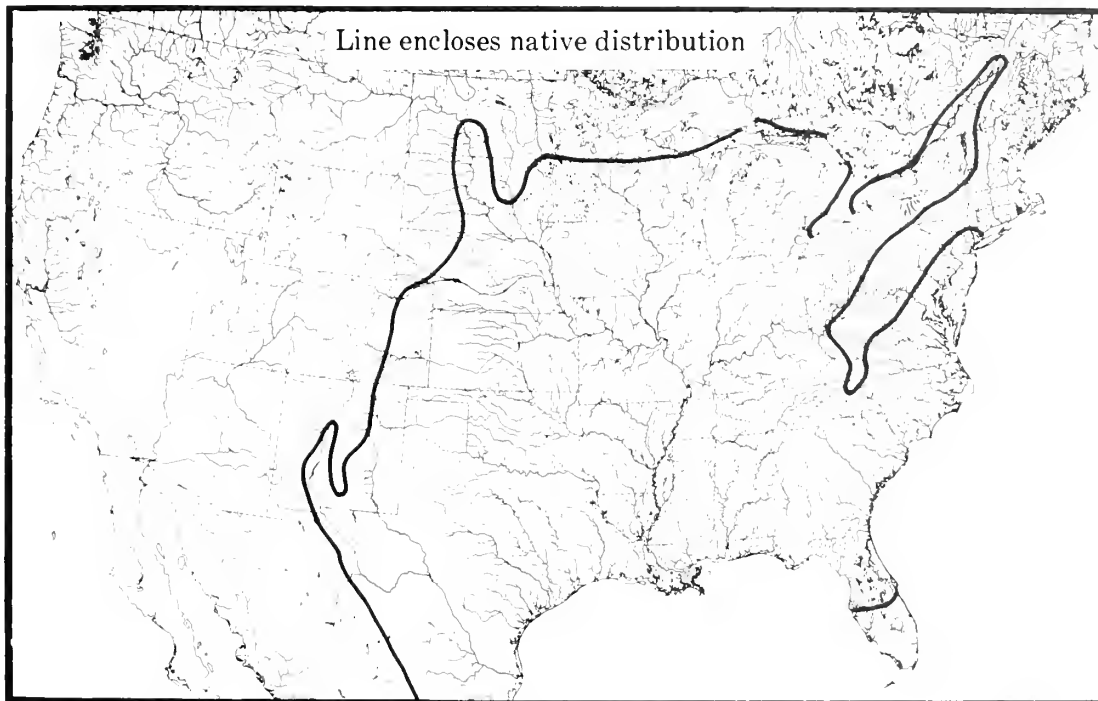
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: Delaware and Chesapeake bays (Lesueur 1818. J. Acad. Sci. Phila. 1:222-32; 359-68).

SYSTEMATICS: Subgenus *Dorosoma*. Five species in genus. Most closely related to *D. anale*, *D. chavesi*, and *D. smithi* of Mexico and Central America. Miller (1960. U.S. Fish Wildl. Serv. Fish. Bull. 60:371-92) presented comprehensive morphometric and meristic data for range of species and did not recognize subspecies. Hybridizes with *D. (Signalosa) petenense* (Minckley and Krumholz 1960. Zoologica 45:171-80). Detailed bibliography of systematics, distribution, and biology provided by Nelson and Rothman (1973. Bull. Am. Mus. Nat. Hist. 150:133-206).



Jordan and Evermann 1900



DISTRIBUTION AND HABITAT: Great Lakes and St. Lawrence River to south-eastern SD and central MN, south across NM, east to Gulf of Mexico and throughout MS and Great Lakes drainages to about 40° N latitude on Atlantic coast. Origin and dispersal in Great Lakes reported by Miller (1956. Trans. Am. Fish. Soc. 86:97-111). Habitats include natural inland lakes, ponds, and pools and backwaters of low gradient streams. Prefers warm water with high phytoplankton production; occupies littoral and limnetic regions in lakes and reservoirs. Commonly enters brackish and occasionally marine waters.

ADULT SIZE: 225-350 mm TL.

BIOLOGY: Spawning occurs with rising water temperature in fresh water from about April through June. May enter brack-

ish water during life cycle. Embryology and early life history reported in Miller (1960). Eggs, larvae and juveniles identified by Cooper (1978. Trans. Am. Fish. Soc. 107: 56-62). Major food items include zooplankton, microcrustaceans, phytoplankton, and detritus. Highly esteemed as forage base. May inhibit growth of more desirable game species through interspecific competition when abundant. Major life history studies include Jester and Jensen (1972. New Mexico State Univ. Agr. Exp. Sta. Res. Rep. 218:1-56), Bodola (1966. U.S. Fish Wildl. Serv., Fish. Bull. 65:391-425), and Pierce (1977. Ph.D. diss., Miami Univ., Oxford, Ohio). See also Nelson and Rothman (1973).

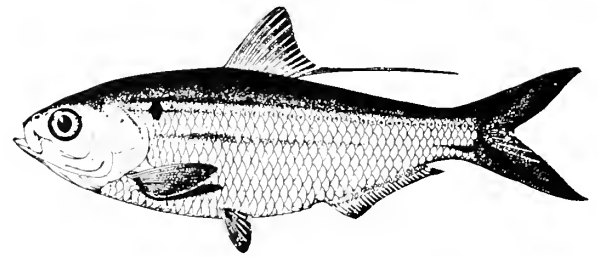
Compiler: B. A. Megrey, June 1979.

Dorosoma petenense (Günther)
Threadfin shad

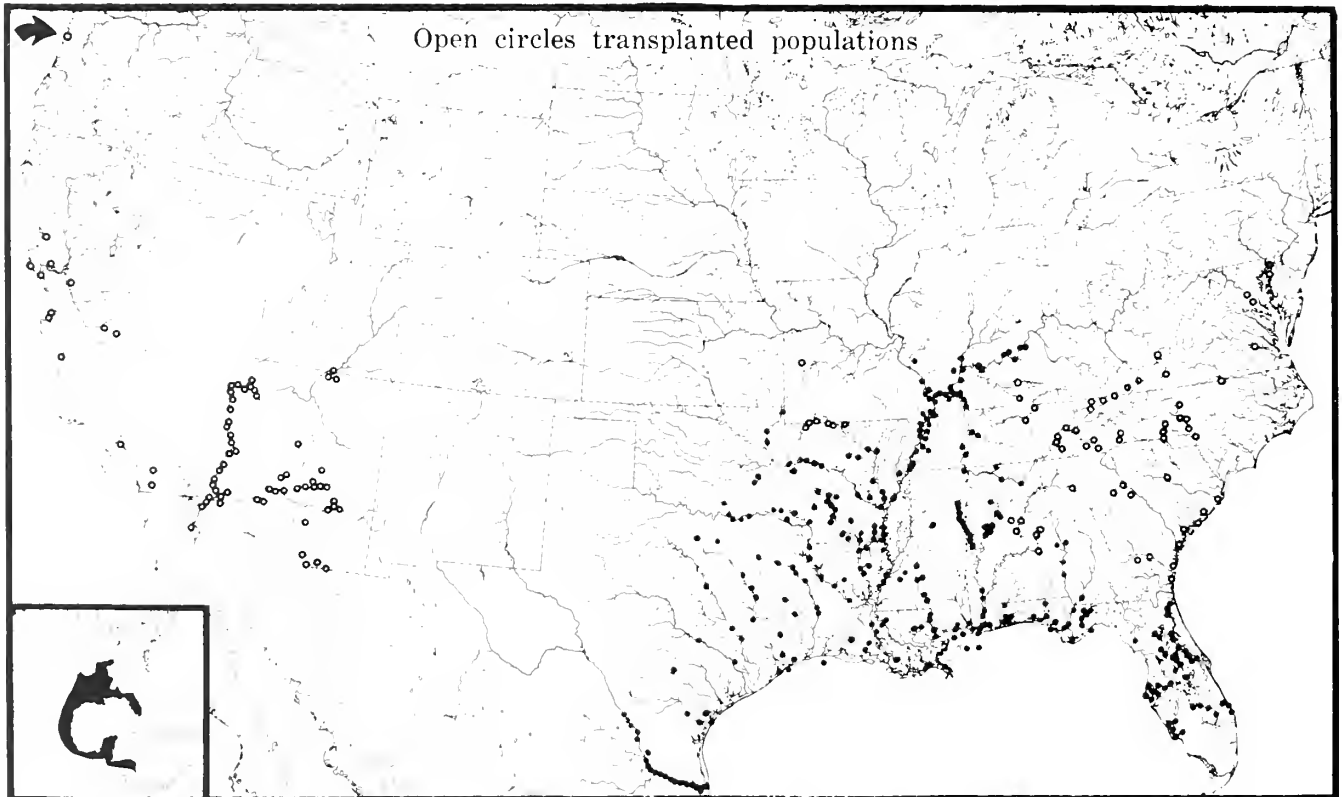
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: Lake Peten, Guatemala (Günther 1866. Proc. Zool. Soc. London: 600-04).

SYSTEMATICS: Subgenus *Signalosa* (Nelson and Rothman 1973. Bull. Am. Mus. Nat. Hist. 150:133-206). Three subspecies of doubtful distinction described: *D. p. atchafalaya*, *D. p. vanhyningi*, and *D. p. campi*. Hybridizes with *D. cepedianum* (Minckley and Krumholz 1960. Zoologica 44:171-80). Synonymies listed by Miller (1964. Genus *Dorosoma* in Mem. Sears Found. Mar. Res. 1[3]: 443-51).



LA: Atchafalaya River, Melville, ca. 11 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Natural range from Ohio River of KY and southern IN west and south to OK, TX, and FL, along coast of Gulf of Mexico to northern Guatemala and Belize (Miller 1964). Widely introduced as forage species, making accurate delineation of natural range difficult. Minckley and Krumholz (1960) discussed recent invasion of Ohio River and summarized early introductions. Habitat similar to *D. cepedianum*: lakes, ponds, larger rivers, estuaries and reservoirs. Often in swifter flowing waters (e.g. bases of spillways) than that species. Introduced into CA in 1955; subsequently moved north to Yaquina Bay, OR (Krygier et al. 1973. Calif. Fish Game 59:140-42) via marine migration.

ADULT SIZE: 75-175 mm TL; maximum 220 mm TL (Guatemala), 178mm TL (United States).

BIOLOGY: Popular forage species widely introduced in warm United States waters. Northern distribution limited by low tolerance of cold temperatures, 7-14°C (Hubbs 1951. Copeia:297; Pflieger 1975. *The Fishes of Missouri*). Spawning may occur at less than a year in open, 21°C waters over plants and other objects (Miller 1964), or under brush and logs (Rawstrom 1964. Calif. Fish Game 50:59). Johnson (1970. Trans. Am. Fish. Soc. 99:739-53; 1971. Trans. Am. Fish. Soc. 100:74-85) reported on reproduction, growth, and population dynamics. Feeds on plankton. Length-weight relationships summarized in Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1). Hoffman (1970. *Parasites of North American Freshwater Fishes*) listed parasites.

Compiler: G. H. Burgess. December 1978.

Harengula jaguana (Poey)
Scaled sardine

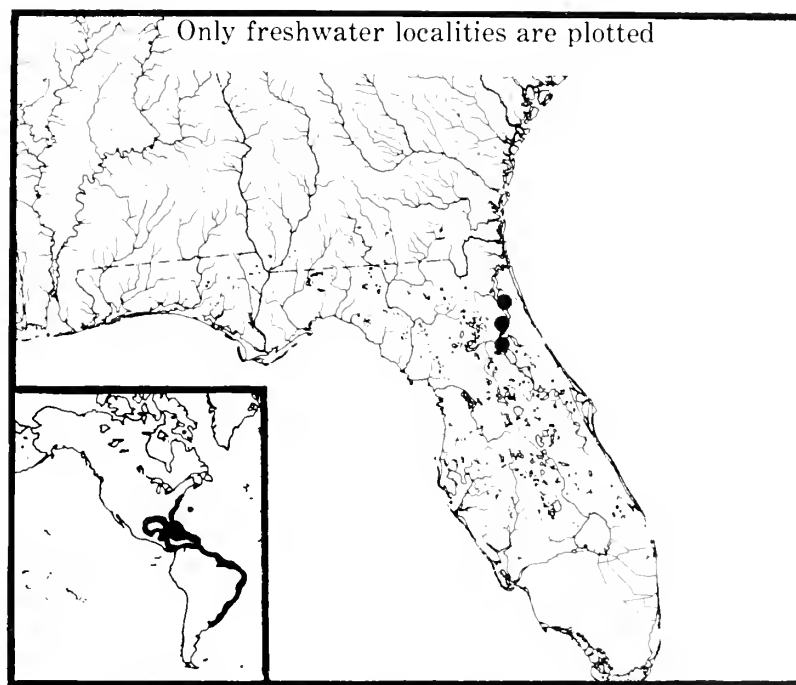
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: Bahia de Jaqua, Cuba (Poey 1865. Repert. Fesico-Nat. Cuba 1: 189-92).

SYSTEMATICS: Species exhibits some geographic variation in body depth, eye size, and gill raker numbers, which led to designation of subspecies (Rivas 1950. Proc. U.S. Natl. Mus. 100:275-309); however, these probably represent a single, variable species (Whitehead 1973. Bull. Br. Mus. [Nat. Hist.] Zool. Suppl. 5:1-227). Closely related to *H. clupeola* and *H. humeralis*. *Harengula pensacolae* is junior synonym.



FL: Dade Co., Key Biscayne,
98 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Widely distributed from SC to Brazil, including Bahamas, Caribbean, northern Gulf of Mexico, and occasionally as far north as NJ. Prefers high salinity (Gunter 1945. Publ. Inst. Mar. Sci. Univ. Tex. 1:1-190; Tabb and Manning 1961. Bull. Mar. Sci. 11:552-649; Gunter and Hall 1963. Gulf Res. Rept. 1:189-307; Christmas and Waller in Christmas [ed.] 1973. Miss. Mar. Conserv. Comm.: 1-434), but reported from fresh water by Tagatz (1968. Q. J. Fla. Acad. Sci. 30:25-50) and questionably by Christmas and Waller (1973). Apparently moves to deeper water in winter.

ADULT SIZE: ca. 85 mm SL, 149 mm SL maximum.

BIOLOGY: Extended spawning from February through August. Other reproductive aspects reported by Martinez and Houde (1975. Bull. Mar. Sci. 25:35-45). Reported to feed on small molluscs and planktonic crustaceans (Reid 1954. Bull. Mar. Sci. 4: 1-94; Springer and Woodburn 1960. Fla. Board Conserv. Prof. Pap. [Ser. 1]:1-104). Growth data presented by Gunter (1945), Springer and Woodburn (1960), and Christmas and Waller (1973). Maximum age about three years.

Compiler: S. W. Ross. June 1979.

Opisthonema oglinum (Lesueur)
Atlantic thread herring

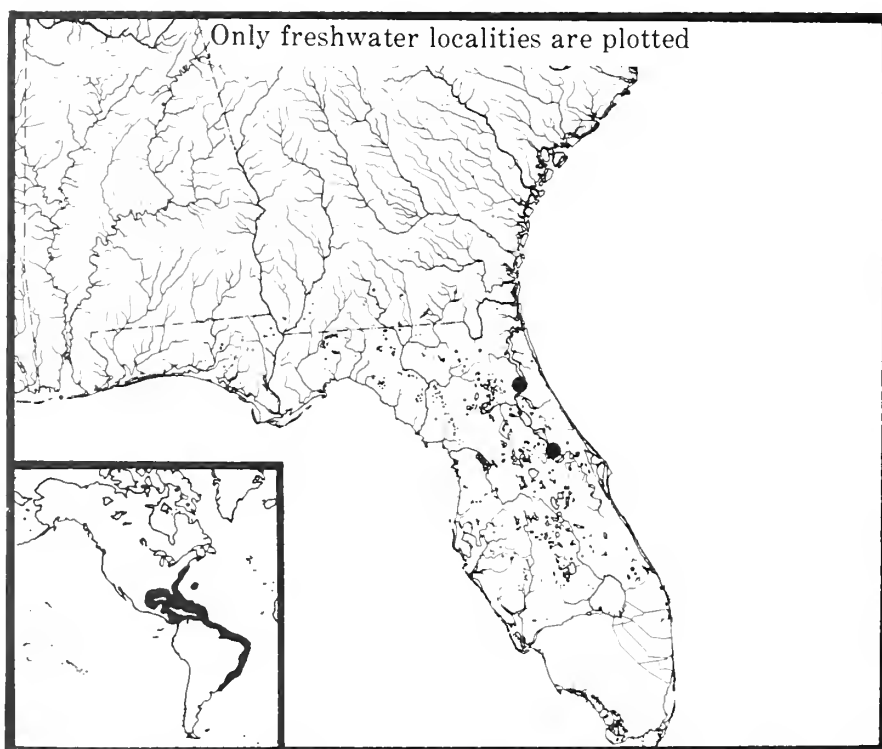
Order Clupeiformes
Family Clupeidae

TYPE LOCALITY: Newport, RI (Lesueur 1818. J. Acad. Nat. Sci. Phila. 1:359-68).

SYSTEMATICS: Berry and Barrett (1963. Bull. Int. Am. Trop. Tuna Comm. 7:113-90) reviewed genus. One of two members of genus in western Atlantic, and only species in United States waters.



FL: Ocean Beach Cape,
144 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Cape Cod, MA, south to Brazil, including Bermuda, Bahamas, Gulf of Mexico, and Caribbean Sea. Generally oceanic or coastal, seeming to prefer higher salinities (Gunter 1945. Publ. Inst. Mar. Sci. Univ. Tex. 1:1-190; Tabb and Manning 1961. Bull. Mar. Sci. 11:552-649; Hildebrand 1963. Family Clupeidae in Mem. Sears Found. Mar. Res. 1[3]:257-454). Reported from fresh water in St. John's River (Tagatz 1968. Q. J. Fla. Acad. Sci. 30:25-50).

BIOLOGY: Food consists chiefly of zooplankton. Spawns offshore from spring through summer (Houde and Fore 1973. Fla. Dep. Nat. Resour. Leaflet Ser. 4[23]: 1-14). Hildebrand (1963) presented data on growth, and Fuss et al. (1969. Proc. Gulf Caribb. Fish. Inst. 21:111-25) reported on maturity, food habits, age, and growth. Egg and larval development described by Richards et al. (1974. Fish. Bull. 72:1123-36.). Houde (1977. Fish. Bull. 75:493-512) estimated abundance and potential yield of eastern Gulf of Mexico populations.

ADULT SIZE: 182 mm SL maximum.

Compiler: S. W. Ross. June 1979.

Anchoa mitchilli (Valenciennes)
Bay anchovy

Order Clupeiformes
Family Engraulidae

TYPE LOCALITY: "New York" (Valenciennes in Cuvier and Valenciennes 1848. *Histoire Naturelle des Poissons* 21:1-536).

SYSTEMATICS: Treated by Jordan and Seale (1926. Bull. Mus. Comp. Zool. 67: 355-418), Hildebrand (1943. Bull. Bingh. Oceanogr. Coll. 8:1-165; 1963. Family Engraulidae in Sears Found. Mar. Res. Mem. 1 [3]: 152-249) and Daly (1970. Bull. Mar. Sci. 20:70-104). Hildebrand (1943) recognized northern (*A. m. mitchilli*) and southern (*A. m. diaphana*) subspecies with intergradation in NC and SC, but variation appears clinal.



FL: Dade Co., Virginia Key,
47 mm SL (NCSM).



DISTRIBUTION AND HABITAT: From Harraseeket River, ME (Kendall 1914. Proc. Portland Soc. Nat. Hist. 3:1-198) (but only as a stray north of Cape Cod) to Yucatan, Mexico, at depths of 0.3-36 m, usually less than 20 m. Extremely euryhaline, abundant in lower freshwater and estuarine reaches of coastal rivers, bays and sounds, and nearshore marine waters in salinities up to 80 ppt (TX: Simmons 1957. Publ. Inst. Mar. Sci. Univ. Tex. 4:156-200); most abundant in salinities less than 20 ppt.

ADULT SIZE: 34-85 mm SL, 102 mm SL maximum.

BIOLOGY: Embryology and early development described by Kuntz (1914. Bull. U.S. Bur. Fish. 33:3-19) and Hildebrand and Cable (1930. Bull. U.S. Bur. Fish. 46: 383-488), summarized in Jones et al. (1978.

Development of Fishes of the Mid-Atlantic Bight Vol. 1). Spring-summer spawner over much of Atlantic coast, but reproduction occurs year around in southern FL (Houde in Jones et al. 1978). Larval food selection and critical food concentrations studied by Detwyler and Houde (1970. Mar. Biol. 7:214-22) and Houde (1978. Bull. Mar. Sci. 28:395-411). Predominantly a planktivore; consumes copepods, insect larvae, mysids, shrimps, and larval fishes (Darnell 1958. Publ. Inst. Mar. Sci. Univ. Tex. 5:353-416; Carr and Adams 1973. Trans. Am. Fish. Sci. 102:511-40; Sheridan 1978. Northeast Gulf Sci. 2:126-32), but feeds on benthic organisms when zooplankton scarce (Odum and Heald 1972. Bull. Mar. Sci. 22: 671-738). Very important forage species for predatory fishes and water birds.

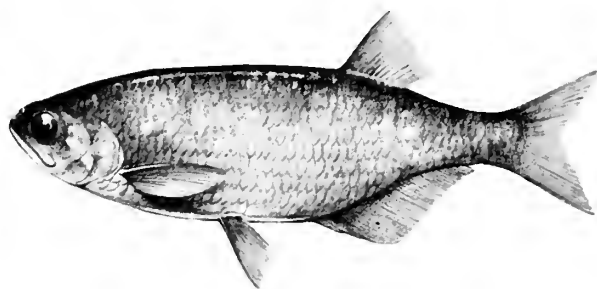
Compiler: G. H. Burgess. June 1979.

***Hiodon alosoides* (Rafinesque)**
Goldeye

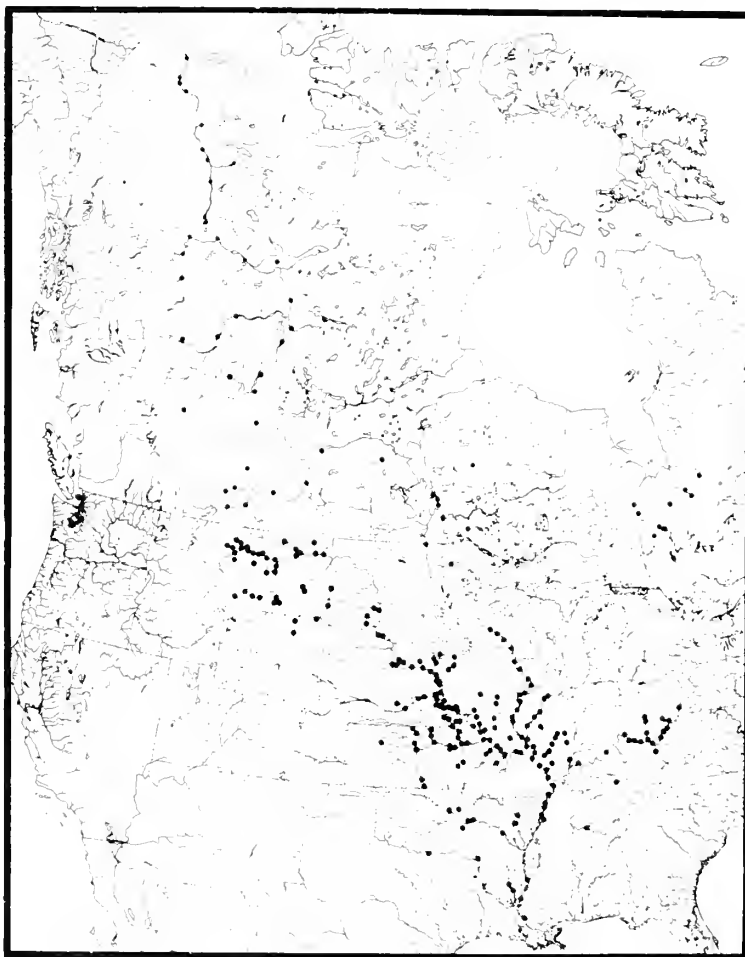
Order Osteoglossiformes
Family Hiodontidae

TYPE LOCALITY: Ohio River (probably Falls of the Ohio River at Louisville, KY) (Rafinesque 1819. *J. Physique, de Chimie et d'Histoire Naturelle* 88:417-29).

SYSTEMATICS: One of two species in monogeneric family, only extant North American members of order Osteoglossiformes. Once placed in a separate genus *Amphiodon*. Family long thought to belong, or be closely related to, order Clupeiformes, but placed in present order following work of Gosline (1960. *Bull. Brit. Mus. (Nat. Hist.) Zool.* 6:327-65; 1962. *Smithson. Misc. Coll.* (1961) 142:1-42) and Greenwood (1963. *Bull. Brit. Mus. (Nat. Hist.) Zool.* 11:377-412). Cavender (1966. *Copeia*: 311-20) reviewed fossil history of family. Kerswill (1937. M.Sc. thesis, Univ. Western Ontario) reviewed systematics of the two Recent species.



AT: Red Deer River (NMC).



DISTRIBUTION AND HABITAT: Lower Mississippi River basin from LA and MS north to Ohio River basin and throughout Great Plains into extreme northwestern Canada, almost to mouth of MacKenzie River (Fort Norman), NT. Widely disjunct population in tributaries of James Bay, ON and QU. Absent from entire Great Lakes drainage. Typically in turbid, often quiet waters of large rivers and lakes, as well as adjacent backwaters. Common in some parts of range, but has disappeared from some areas (e.g. upper Tennessee River) where man-made changes (particularly impoundments) have modified natural conditions.

ADULT SIZE: ca. 500 mm TL maximum.

BIOLOGY: Several detailed biological studies for this species have been summarized by Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) and Scott and Crossman (1973. *Freshwater Fishes of Canada*). Tolerant of highly turbid conditions, more so than *H. tergisus*. Spawns from May to July in Canada, at temperatures of 10-12.8°C, in pools of rivers or backwaters of lakes. Females may contain 5,000-25,000 eggs. Lives at least 14 years in some areas. Food includes surface and aquatic insects, other invertebrates (including crustaceans and molluscs), and occasionally small fishes. Commercially important in some places.

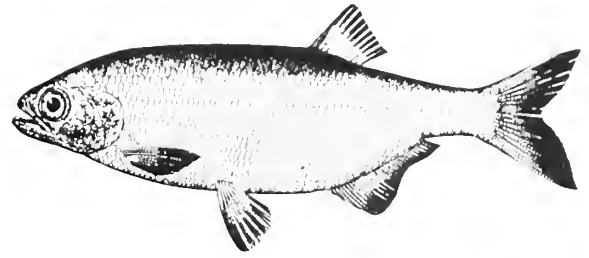
Compiler: C. R. Gilbert, August 1978.

***Hiodon tergisus* Lesueur**
Mooneye

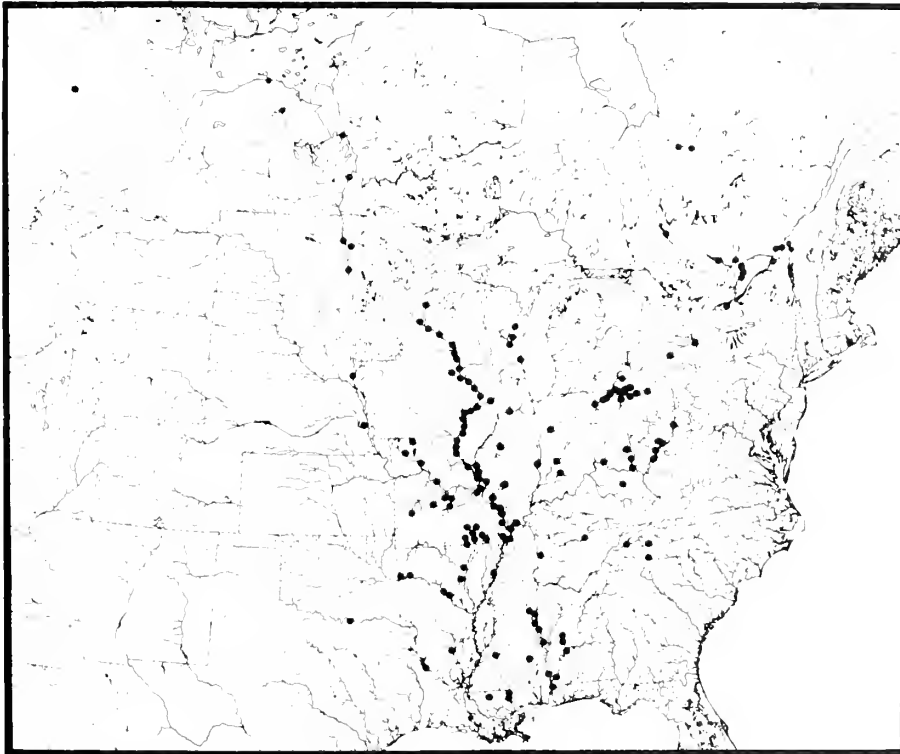
Order Osteoglossiformes
Family Hiodontidae

TYPE LOCALITY: Ohio River at Pittsburgh, PA, and Lake Erie at Buffalo, NY (Lesueur 1818. J. Acad. Nat. Sci. Phila. 1:222-35, 359-68).

SYSTEMATICS: One of two species in monogeneric family, only extant North American members of order Osteoglossiformes. Family long thought to belong, or be closely related to, order Clupeiformes but placed in present order following work of Gosline (1960. Bull. Brit. Mus. [Nat. Hist.] Zool. 6:327-65; 1962. Smithsonian. Misc. Coll. [1961] 142:1-42) and Greenwood (1963. Bull. Brit. Mus. [Nat. Hist.] Zool. 11:377-412). Cavender (1966. Copeia: 311-20) reviewed fossil history of family. Kerswill (1937. M. Sc. thesis, Univ. Western Ontario) reviewed systematics of the two Recent species.



MI: Encorse (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Mobile Bay drainage west to Mississippi River basin (including Pearl River) north throughout most of Mississippi Valley (but excluding most of Great Plains region). Throughout most of Great Lakes basin (including upper St. Lawrence) except Lake Superior, and north into Hudson Bay basin of south-central Canada (MB, SA, and western ON). Semi-disjunct population in James Bay region, ON and QU. In large rivers and lakes, generally in clearer, less turbid water than *H. alosoides*. Sometimes common, but reduced in numbers in some places (e. g. Lake Erie) because of environmental changes.

ADULT SIZE: ca. 445 mm TL maximum.

BIOLOGY: Since this species is less important commercially than *H. alosoides*, fewer biological studies exist. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) and Scott and Crossman (1973. *Freshwater Fishes of Canada*) summarized available information. Spawns from April to early June in Lake Erie; migrates up large, clear streams to spawn in southern parts of range. Females may have from 10,000 to 20,000 eggs. Reaches eight years of age in Lake Erie (Van Oosten 1961. Trans. Am. Fish. Soc. 90:170-74). Food consists primarily of aquatic and terrestrial insects but may also include crustaceans, molluscs, and small fishes.

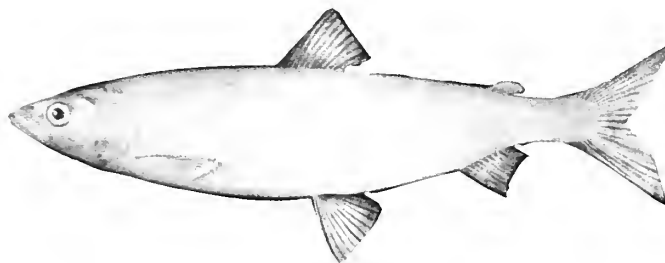
Compiler: C. R. Gilbert. August 1978.

Coregonus alpenae (Koelz)
Longjaw cisco

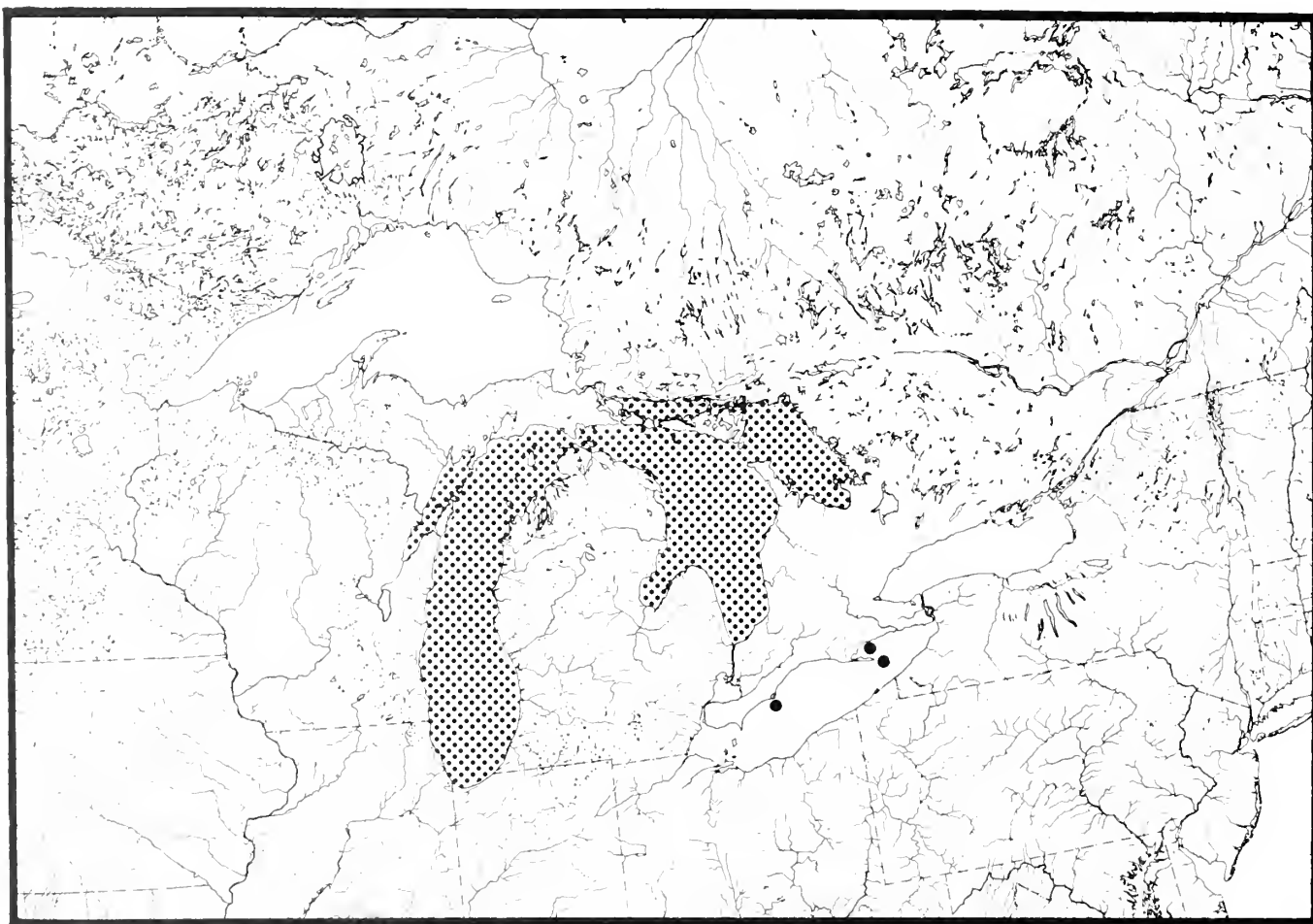
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lake Michigan off Ile aux Galets, 35 km nne of Charlevoix, MI (Koelz 1924. Occas. Pap. Mus. Zool. Univ. Mich. 146:1-8).

SYSTEMATICS: Subgenus *Leucichthys*. *Coregonus alpenae* probably not a valid species but a variant of *C. zenithicus* (Todd and Smith, unpubl. data).



MI: Lake Michigan, male,
(USFWS).



DISTRIBUTION AND HABITAT: Previously common in deep waters (50-100 m) of lakes Michigan, Huron, and Erie. Most likely extinct. Single specimen taken in Georgian Bay (Lake Huron), ON, in 1975. Prior to that some identified in Grand Traverse Bay (Lake Michigan), MI, in 1968.

ADULT SIZE: 270-340 mm SL.

BIOLOGY: Summary provided by Scott and Crossman (1973. *Freshwater Fishes of Canada*). Ecology discussed by Koelz (1929. Bull. U.S. Bur. Fish. [1927] 43:297-643) and Jobes (1949. Trans. Am. Fish. Soc. [1946] 76:215-47). Spawned in late fall and ate primarily *Mysis relicta*. Parasites reported by Bangham (1955. Am. Midl. Nat 53:184-94).

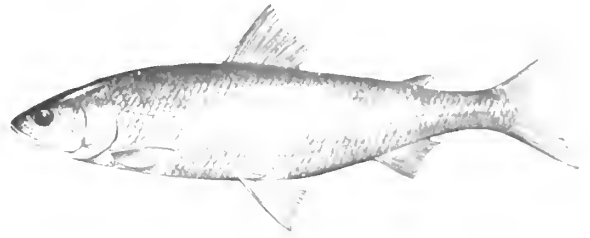
Compiler: T. N. Todd. October 1978.

Coregonus artedii Lesueur
Cisco or lake herring

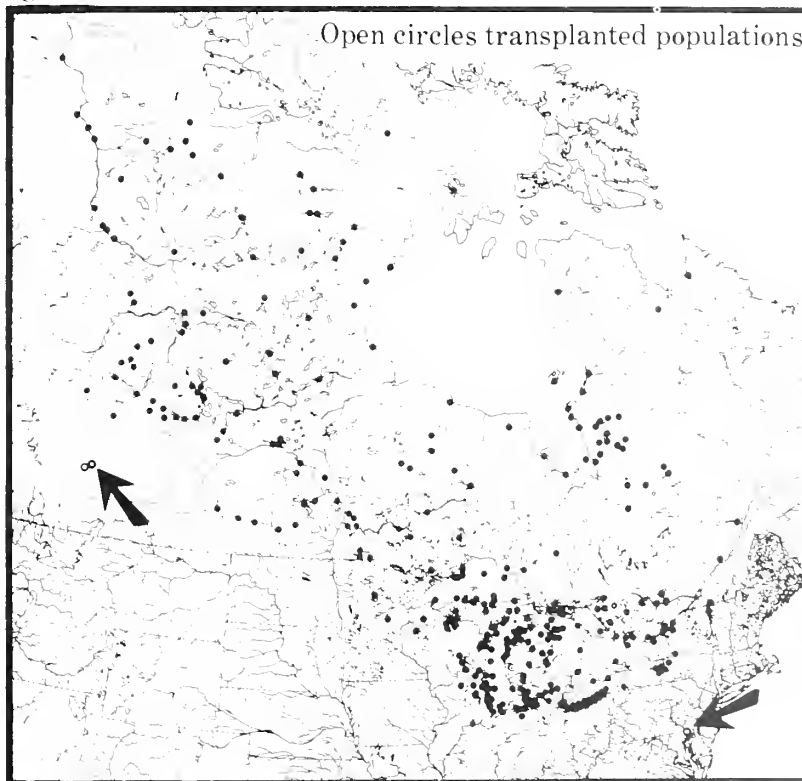
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lake Erie at Buffalo, and Niagara River at Lewiston, Canada (Lesueur 1818. J. Acad. Nat. Sci. Phila. 1:222-35; 359-68).

SYSTEMATICS: Subgenus *Leucichthys*. Endemic North American ciscoes not conspecific with *Coregonus albula* (Behnke 1972. J. Fish. Res. Board Can. 29:639-71). Great phenotypic variability of *C. artedii* has led to recognition of 22 subspecies (Hubbs and Lagler 1964. *Fishes of the Great Lakes Region*), whereas McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*) considered it a species complex. Scott and Crossman (1973. *Freshwater Fishes of Canada*) and Clarke (1973. Ph.D. diss., Univ. Manitoba), included *C. nipigon* within *C. artedii*. Considering ciscoes outside Great



QU: Hudson Bay, Povungnituk.
262 mm SL (NMC).



Lakes basin, Clarke (1973) also included some *C. hoyi*, all *C. nigripinnis*, and one population of *C. zenithicus* in *C. artedii*, but excluded some ciscoes previously identified as *C. artedii*. Several lakes contain two or more sympatric forms of *C. artedii* (McPhail and Lindsey 1970; Clarke 1973). **DISTRIBUTION AND HABITAT:** Widespread from upper Mississippi River and Great Lakes basins north to Labrador and northwest to Mackenzie River drainage, but absent from upper reaches of Liard, Peace, Athabasca, and Saskatchewan rivers. Occurs mainly in lakes, but also in large rivers and in coastal waters of Hudson Bay. Distribution

map includes populations previously identified as *C. hoyi*, *C. nigripinnis*, and *C. nipigon*; some dots represent populations from more than one lake.

ADULT SIZE: 100 - 485 mm FL.

BIOLOGY: Summarized by McPhail and Lindsey (1970) and Scott and Crossman (1973). Sympatric forms of *C. artedii* may differ in vertical distribution, food, growth and size at maturity (Clarke 1970. M.Sc. thesis, Univ. Manitoba), and in time of spawning (Kooyman 1970. M.Sc. thesis, Univ. Calgary, Alberta).

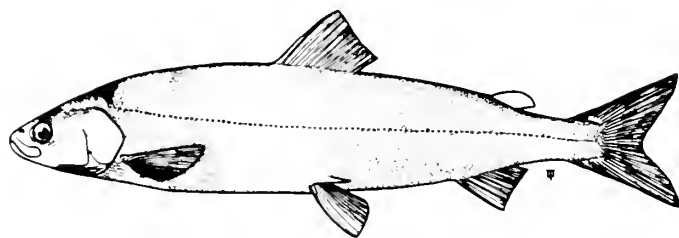
Compiler: R. McV. Clarke. October 1978.

Coregonus autumnalis (Pallas)
Arctic cisco

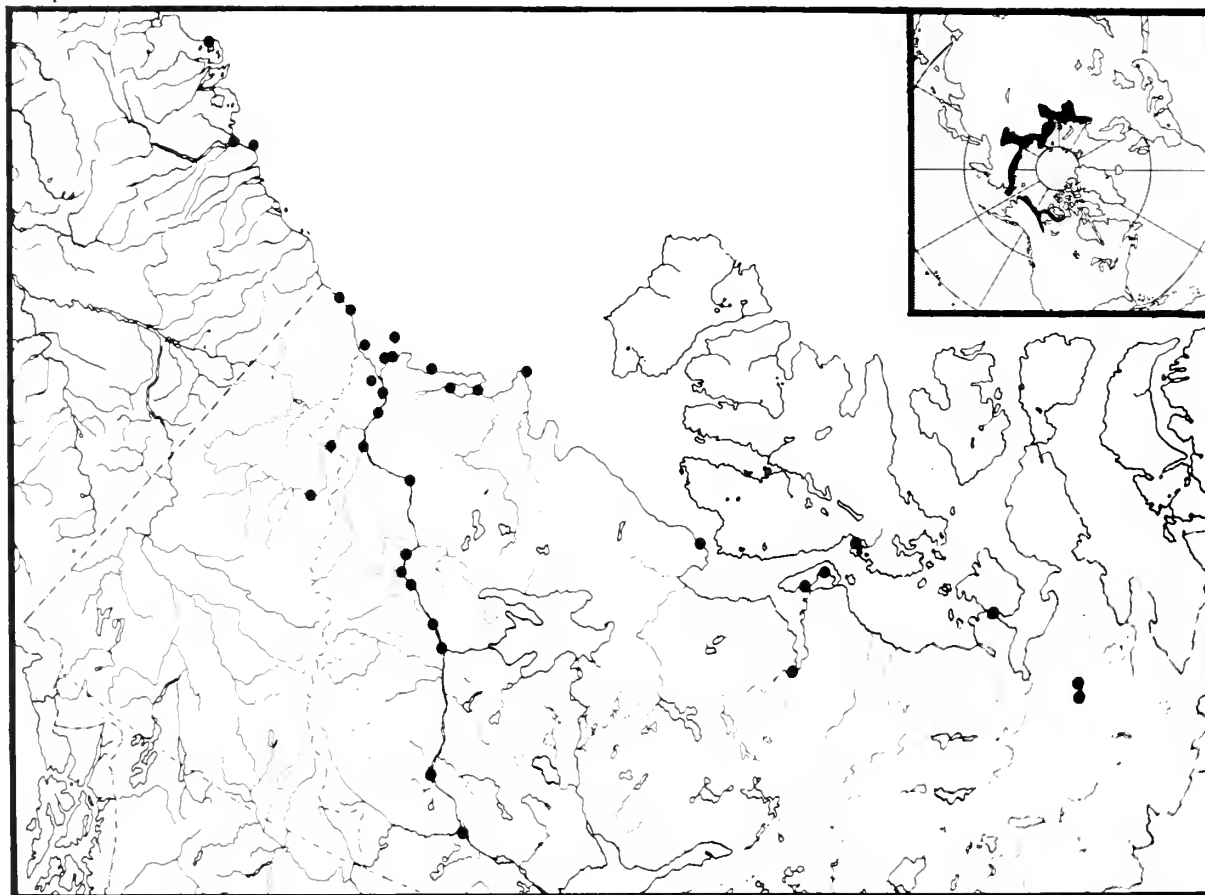
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Pechor and Enissei rivers, western Siberia, USSR (Pallas 1776. *Reise durch verschiedene Provinzen des Russischen Reichs* [1768-74] Vol. 3).

SYSTEMATICS: Subgenus *Leucichthys*. *Coregonus autumnalis* and *C. laurettae* confused until McPhail (1966. J. Fish. Res. Board Can. 23:141-48) proved validity of both species; differentiation may have occurred during Wisconsin glaciation. Irish *Coregonus* conspecific with *C. autumnalis* (Ferguson et al. 1978. J. Fish Biol. 12:221-33). Lake Baikal population considered a distinct subspecies, *C. a. migratorius* (Nikolsky and Reshetnikov in Lindsey and Woods 1970. *Biology of Coregonid Fishes*:251-66), or distinct species, *C. migratorius* (Shaposhnikova in Lindsey and Woods 1970: 195-207).



NT: Mackenzie Dist., Mackenzie River, Peel Channel, 321 mm SL (NMC).



DISTRIBUTION AND HABITAT: Anadromous populations occur in Arctic coastal waters and in estuaries and rivers draining into Arctic Ocean in Russia, Siberia, AK, and Canada. Landlocked populations occur in Lake Baikal and some Irish loughs. Occurs in North America from Point Barrow, AK, east to Murchison River, NT, and ascends Mackenzie River to Fort Simpson.

ADULT SIZE: 300-640 mm FL.

BIOLOGY: Summarized by McPhail and Lindsey (1970. *Freshwater Fishes of North-western Canada and Alaska*) and Scott and Crossman (1973. *Freshwater Fishes of Canada*). Anadromous in North America; enters Mackenzie River system in late June, spawns late September or early October in tributaries, and moves downstream to the sea in October (Stein et al. 1973. *Fish Resources of the Mackenzie River Valley*, Env.-Soc. Progr. N. Pipelines).

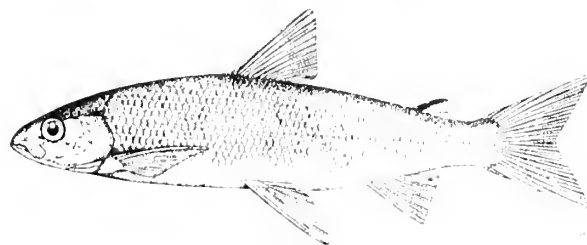
Compiler: R. McV. Clarke. October 1978.

Coregonus canadensis Scott
Atlantic whitefish

Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Tusket River system (Yarmouth Co.) and Millipsigate (= Leipsigate) Lake (Lunenburg Co.), NS (Scott 1967, *Freshwater Fishes of Eastern Canada*).

SYSTEMATICS: First reported by Piers (1927, Proc. Trans. N. S. Inst. Sci. 16:92-95) and described as distinct from *C. clupeaformis* by Scott (1967). Species name is pre-occupied and a new name needs to be proposed. For this reason, this name does not appear in the American Fisheries Society Checklist.



(NCSM)



DISTRIBUTION AND HABITAT: Only in southern NS where known from Yarmouth Harbour, Tusket River system at hydro-electric dam, and Leipsigate Lake. Dam has inadequate fish ladder, which threatens continued survival. Numbers severely reduced and has been placed on list of rare and endangered fishes of Canada as endangered (McAllister and Gruchy 1977, Proc. Symp. Canada's threatened species and habitats, Can. Natl. Fed., Ottawa). Anadromous; in freshwater found in swift currents (Piers 1927).

ADULT SIZE: 150-400 mm TL.

BIOLOGY: Little known. Tusket River population migrates upstream in October and returns to sea in early spring (J. Gilhen, ms). Stomachs of Yarmouth Harbour specimens contained amphipods, periwinkles, and marine worms. Pearl organs develop on scales of flanks and top and sides of head. Piers (1927) reported that whitefish in Leipsigate Lake school.

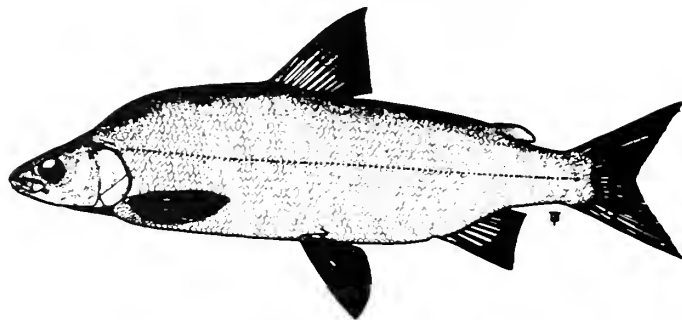
Compilers: J. Gilhen, D. E. McAllister, and W. B. Scott, May 1978.

***Coregonus clupeaformis* (Mitchill)**
Lake whitefish

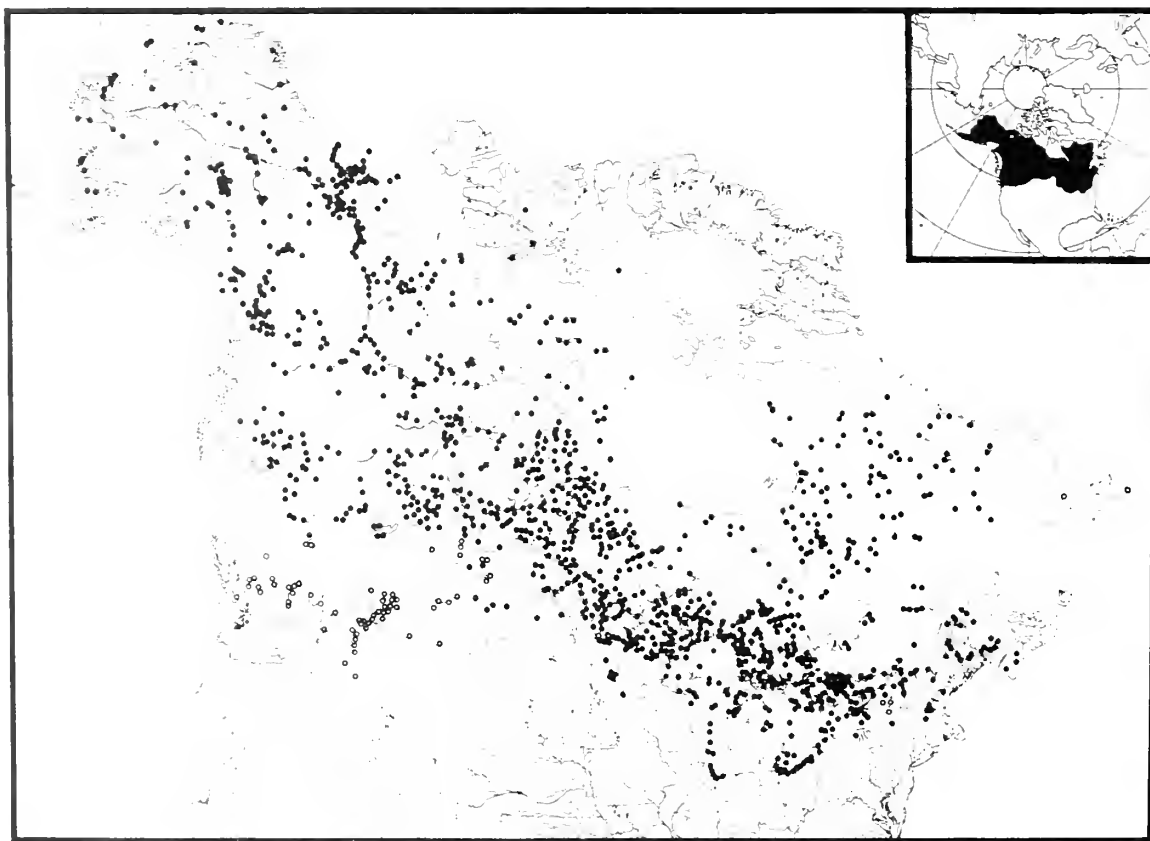
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Falls of St. Mary's River, Chippewa Co., MI (Mitchill 1818. Am. Mon. Mag. Crit. Rev. [1817-1818] 2:241-48; 321-28).

SYSTEMATICS: As with many other coregonid and salmonid species in which a range of ecophenotypes occurs, the systematics of *C. clupeaformis* is confused. Synonymized with three Eurasian species (Walters 1955. Bull. Am. Mus. Nat. Hist. 106 [5] 5:259-368; Svardson 1957. Rep. Inst. Freshwater Res. Drottningholm 38:261-356; Gasowska 1960. Ann. Zool. Inst. Zool. Polska Akad. Nauk 18: 471-513). Lindsey (1962. J. Fish. Res. Board Can. 19:687-714) clarified distinctness of *C. clupeaformis* from *C. nasus*.



NT: Mackenzie River, 206 mm
SL (NMC).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: In North America, from Atlantic coastal watersheds west across Canada and northern United States to BC, YU, and AK. Usually common. In most large lakes and larger rivers. Enters brackish water in NT, Hudson Bay and Strait. Introduced in southern BC, NF, NS, and southern AT as a forage fish.

ADULT SIZE: 500-650 mm, 798 mm TL maximum.

BIOLOGY: Spawns in fall, usually over hard or stony bottoms (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Hart

(1930. Contrib. Can. Biol. Fish. 6:165-214) studied egg and larval development. Bottom feeder over most of range, consuming invertebrates and small fish. Feeds on plankton and terrestrial insects in some regions (Scott and Crossman 1973). Kennedy (1953. J. Fish. Res. Board Can. 10:413-41) determined that individuals in Great Slave Lake, Canada, occasionally may live as long as 28 years, but life span more commonly 5-15 years.

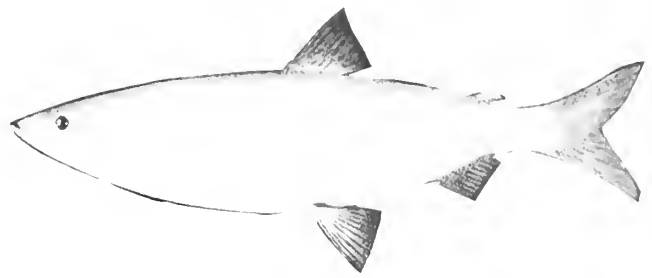
Compilers: B. T. Parker, D. E. McAllister, and S. T. Kucak. October 1979.

Coregonus hoyi (Gill)
Bloater

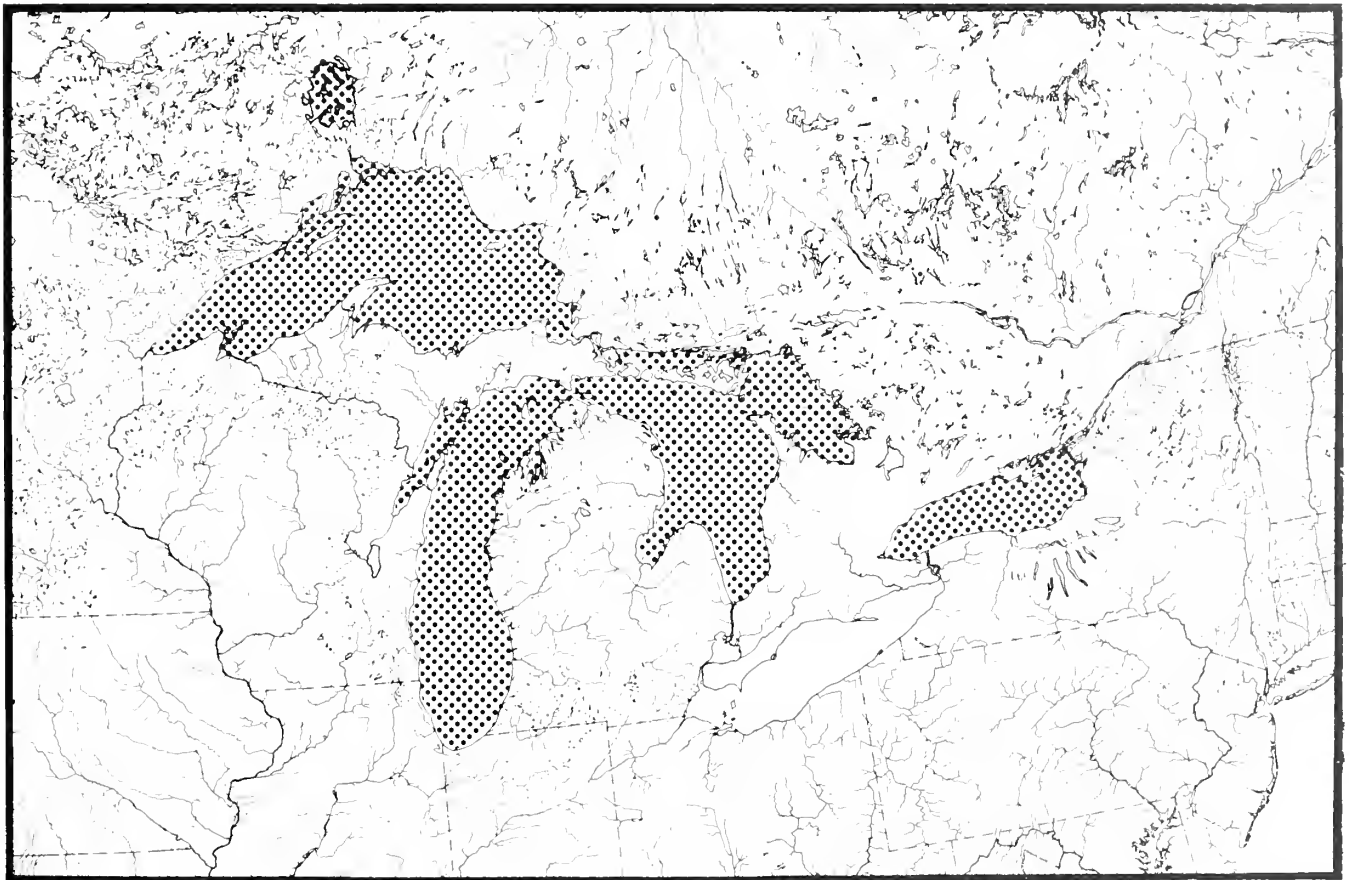
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lake Michigan off Racine, WI (Gill *in* Hoy 1872. Wis. Acad. Sci. Arts Lett. [1870-72] 1:98-101).

SYSTEMATICS: Subgenus *Leucichthys*. Very similar to *C. kiyi*. Appears to hybridize frequently with *C. artedii*, particularly when populations stressed. All populations previously called *C. hoyi* outside of Great Lakes drainage recently equated with *C. artedii* or *C. zenithicus* (Scott and Crossman 1973. *Freshwater Fishes of Canada*; Clarke 1973. Ph.D. diss., Univ. Manitoba; Crossman 1976. *Quetico fishes*).



WI: Lake Michigan, male,
(USFWS).



DISTRIBUTION AND HABITAT: Apparently endemic to Great Lakes, except Lake Erie; probably extirpated from lakes Ontario and Nipigon. Relatively common in deep water (30-189 m).

ADULT SIZE: 200-300 mm SL.

BIOLOGY: Summary provided by Scott and Crossman (1973). General ecology and distribution discussed by Koelz (1929. Bull. U.S. Bur. Fish. 43:297-643), Pritchard (1931. Publ. Ont. Fish. Res. Lab. 41:1-78), and Jobes (1949. Pap. Mich. Acad. Sci. Arts Lett. 1947. 33:135-72). Usually spawns in February and March over all types of bottoms from 35-90 m, but may spawn through-

out year (Jobes 1949; Dryer and Beil 1968. Trans. Am. Fish. Soc. 97:146-58). Population changes discussed by Dryer and Beil (1968) and Brown (*in* Lindsey and Woods 1970. *Biology of Coregonid Fishes*: 501-14). Food is primarily *Pontoporeia affinis* and *Mysis relicta* (Wells and Beeton 1963. Trans. Am. Fish. Soc. 92:245-55). Larval distribution reported by Wells (1966. Trans. Am. Fish. Soc. 95:388-96). Temperature tolerance discussed by Edsall et al. (1970. J. Fish. Res. Board Can. 27:2047-52). Parasites reported by Bangham (1955. Am. Midl. Nat. 53:184-94).

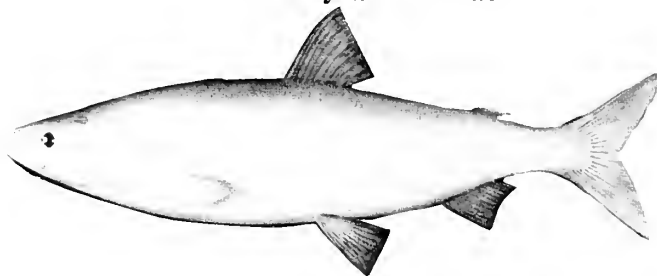
Compiler: R. McV. Clarke and T. N. Todd.
October 1978.

***Coregonus johannae* (Wagner)**
Deepwater cisco

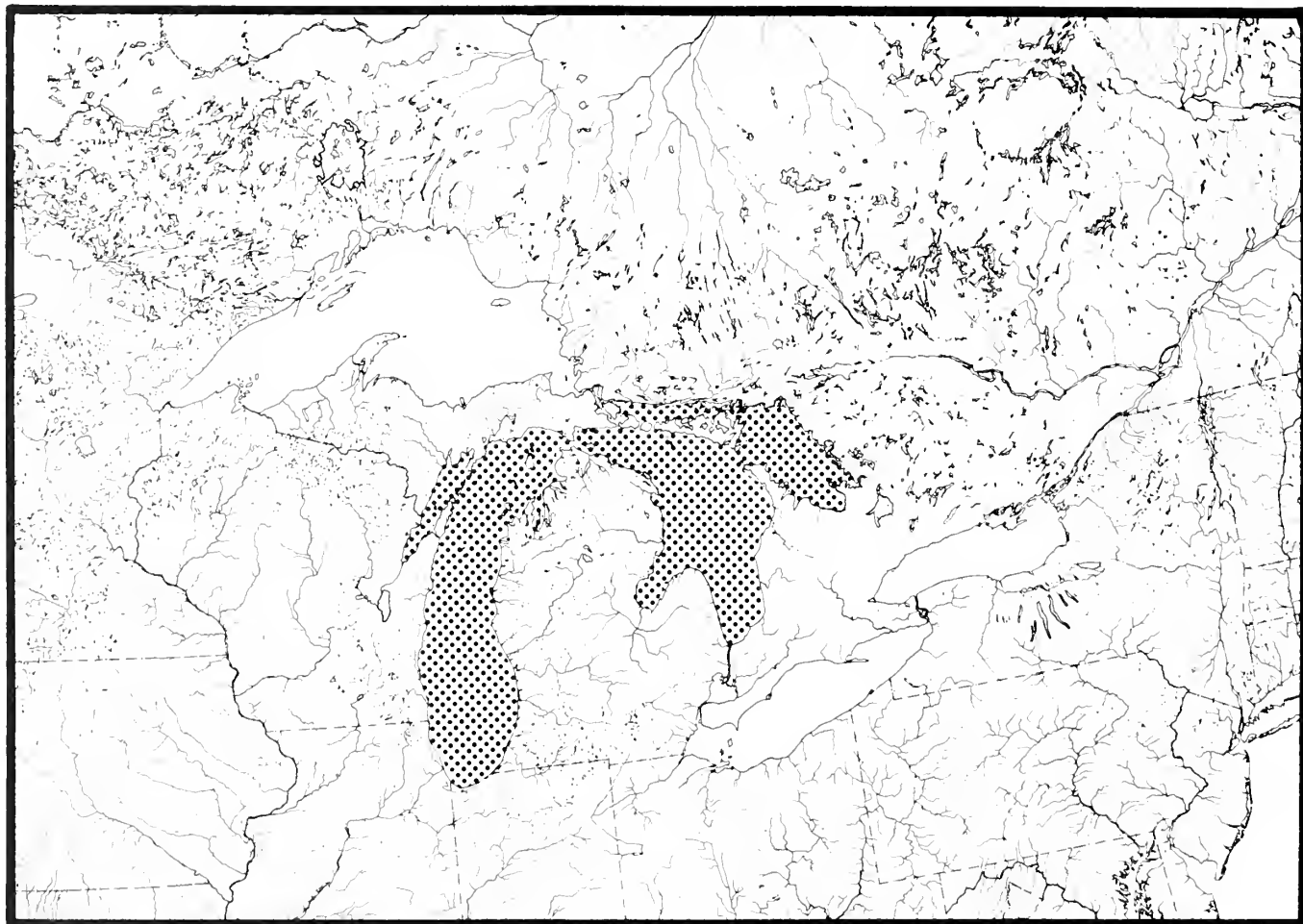
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lake Michigan, 29 km off Racine, WI (Wagner 1910. Science 31: 957-58).

SYSTEMATICS: Subgenus *Leucichthys*. Very similar to *C. zenithicus* with which it may be conspecific.



MI: Lake Michigan, male, (USFWS).



DISTRIBUTION AND HABITAT: Endemic to lakes Michigan and Huron at depths of 50-160 m. Almost certainly extinct. Last specimen seen in 1951.

BIOLOGY: Summary provided by Scott and Crossman (1973. *Freshwater Fishes of Canada*). Ecology discussed by Koelz (1929. Bull. U.S. Bur. Fish. [1927] 43:297-643). Decline in fishery reported by Smith (1964. Trans. Am. Fish. Soc. 93:155-63). Parasites reported by Hoffman (1967. *Parasites of North American Freshwater Fishes*). Only species of cisco known to spawn in August and September in lakes Michigan and Huron.

ADULT SIZE: 250-300 mm SL.

Compiler: T. N. Todd. October 1978.

***Coregonus kiyi* (Koelz)**
Kiyi

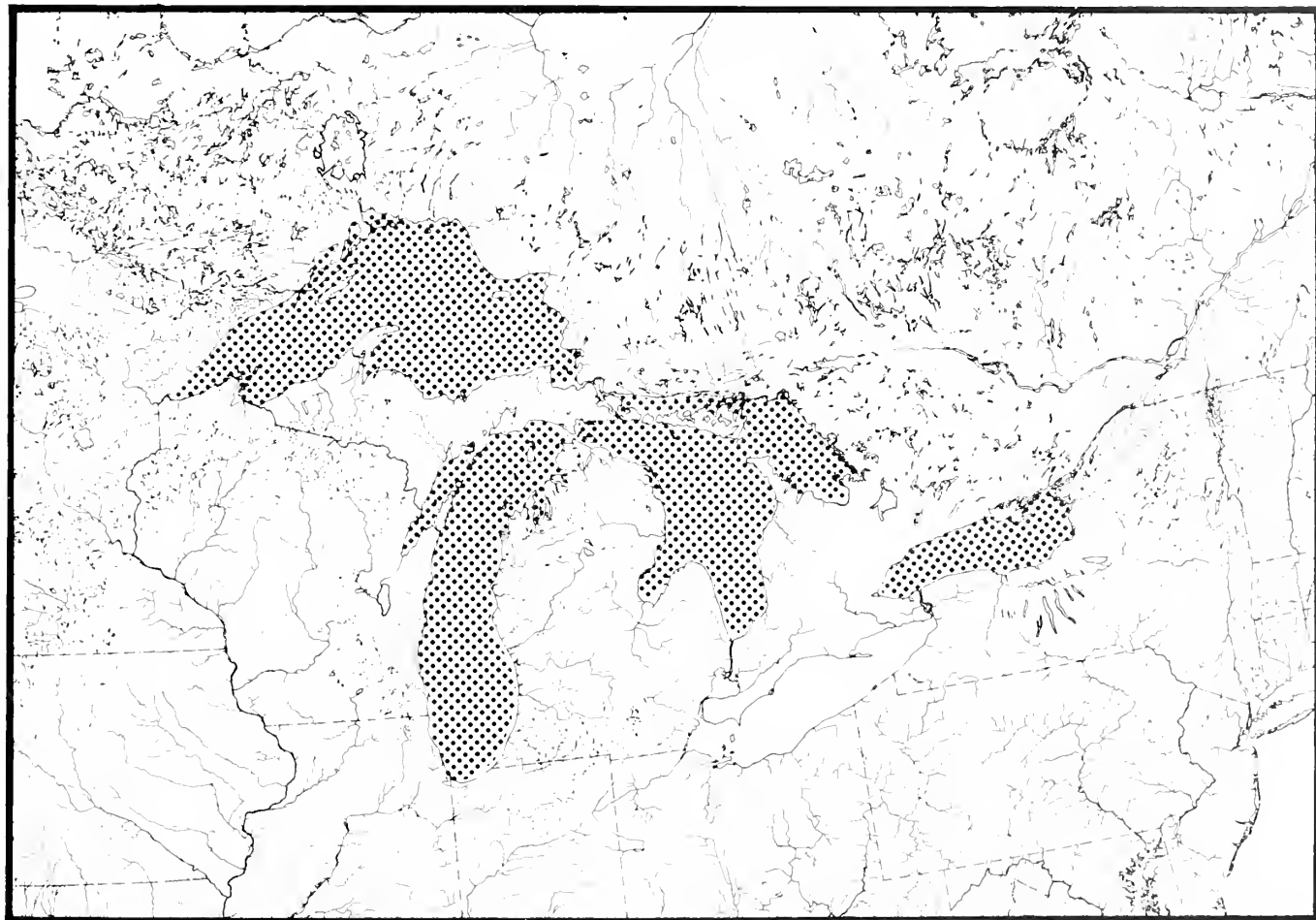
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lake Michigan, 19 km se of Sturgeon Bay, WI (Koelz 1921. Occas. Pap. Mus. Zool. Univ. Mich. 104:1-4).

SYSTEMATICS: Subgenus *Leucichthys*. Very similar to *C. hoyi*. Two subspecies, *C. k. kiyi* from lakes Michigan, Huron, and Superior and *C. k. orientalis* from Lake Ontario.



WI: Lake Michigan, female, (USFWS).



DISTRIBUTION AND HABITAT: Relatively common at depths of 100-180 m in Lake Superior; extremely rare in Lakes Michigan and Huron; presumed extirpated from Lake Ontario where last specimen was seen in 1964.

ADULT SIZE: 140-250 mm SL.

BIOLOGY: Summary provided by Scott and Crossman (1973. *Freshwater Fishes of Canada*). General ecology discussed by Koelz (1929. Bull. U.S. Bur. Fish. [1927] 43:297-643), Pritchard (1931. Pub. Ontario Fish. Res. Lab. 41:1-78), Deason and Hile (1947. Trans. Am. Fish. Soc. [1944] 74:88-142), and Hile and Deason (1947. Trans. Am. Fish. Soc. [1944] 74:143-65). Hoffman (1967. *Parasites of North American Freshwater Fishes*) reported on parasites.

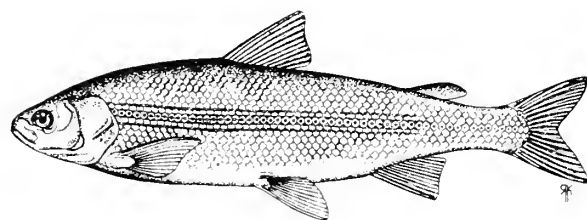
Compiler: T. N. Todd. October 1978.

Coregonus laurettae Bean
Bering cisco

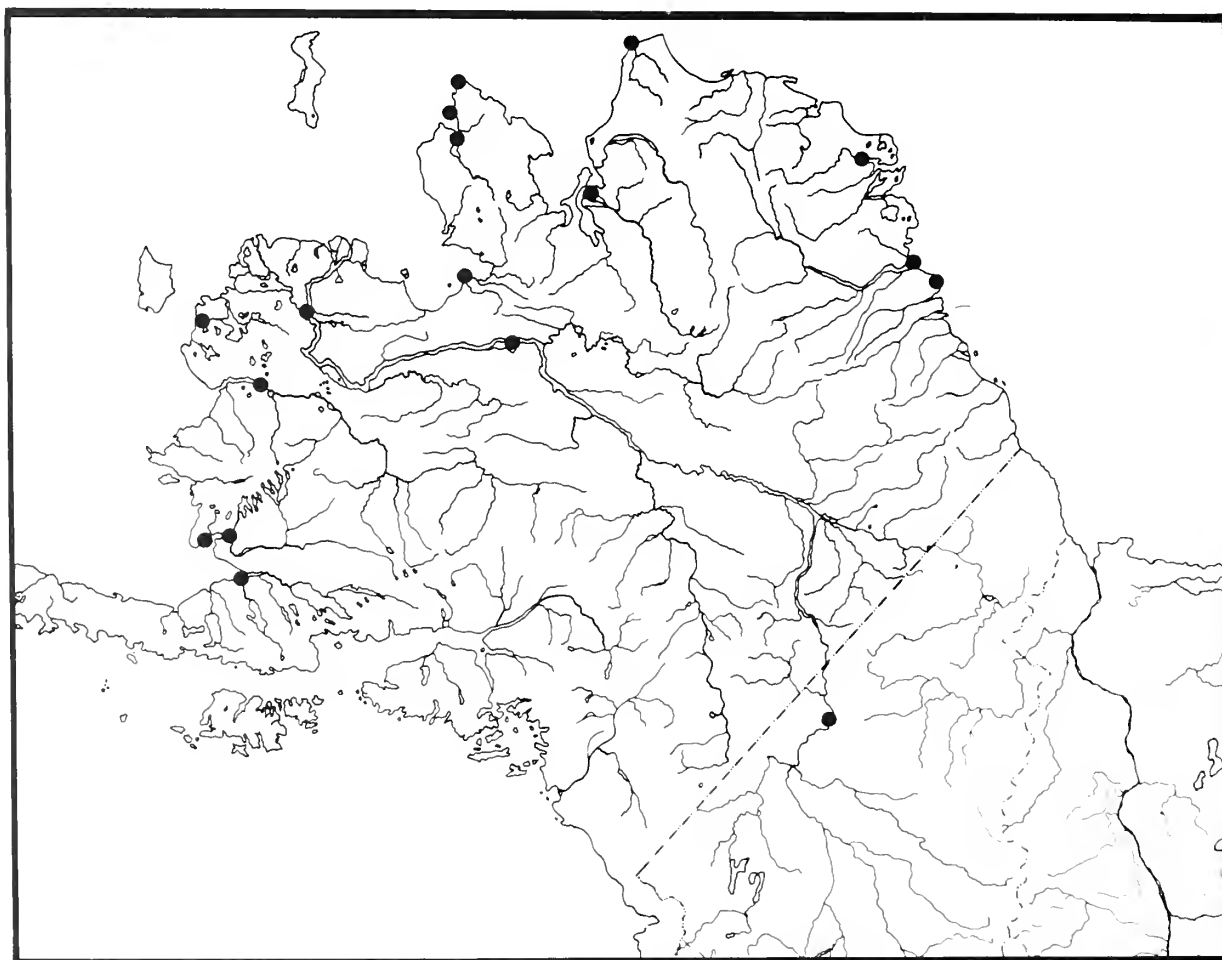
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Point Barrow, AK (Bean 1881. Proc. U.S. Natl. Mus. 4: 144-59).

SYSTEMATICS: Subgenus *Leucichthys*. *Coregonus laurettae* and *C. autumnalis* were confused until McPhail (1966. J. Fish. Res. Board Can. 23: 141-48) demonstrated validity of both species; *C. laurettae* has 21-25 gill-rakers on lower limb of first gill arch, *C. autumnalis* has 26-30. Differentiation may have occurred during Wisconsin glaciation.



(NCSM)



DISTRIBUTION AND HABITAT: Coast of AK, near river mouths and in brackish lagoons, from Cook Inlet north and east to Oliktok near mouth of Colville River. May occur in Chukotsk and Kamchatka regions of Siberia (McPhail and Lindsey 1970. *Freshwater Fishes of Northwestern Canada and Alaska*). Probably anadromous.

BIOLOGY: Little known, but life history presumed to be similar to that of *C. autumnalis* (McPhail and Lindsey 1970). Adults feed mainly on amphipods (McPhail and Lindsey 1970). Nothing known of age and growth (McPhail and Lindsey 1970).

ADULT SIZE: 250-360 mm TL.

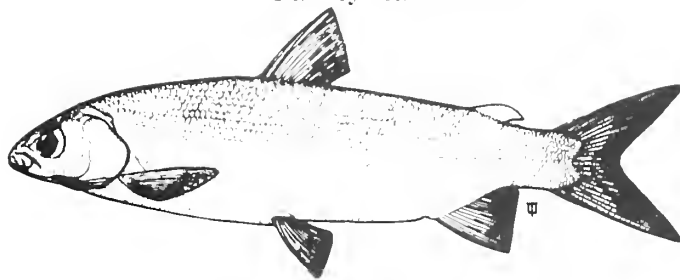
Compiler: R. McV. Clarke. May 1979.

***Coregonus nasus* (Pallas)**
Broad whitefish

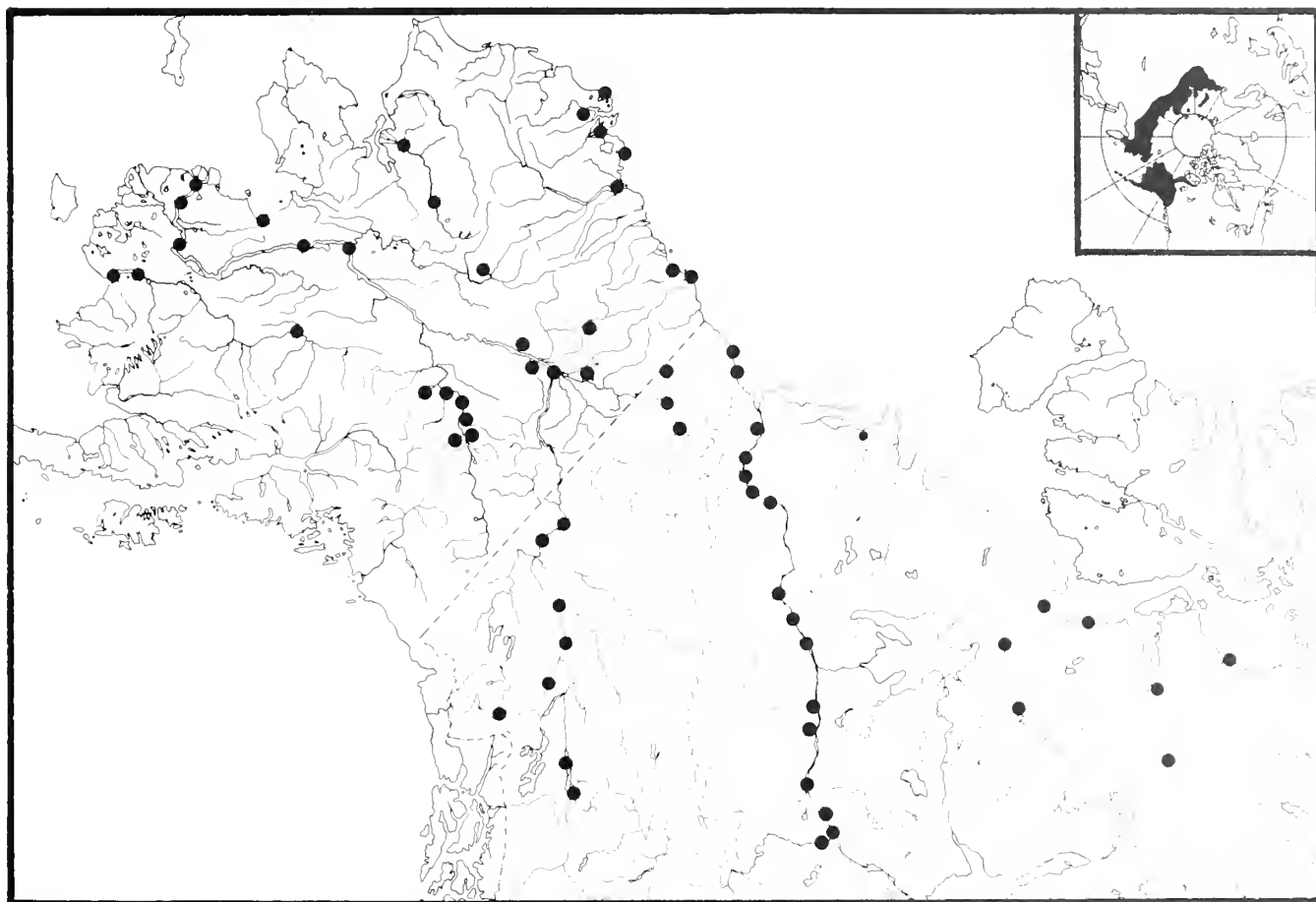
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Bay of Ob, USSR (Pallas 1776. *Reise durch verschiedene Provinzen des Russischen Reichs* [1768-74] Vol. 3).

SYSTEMATICS: Perplexing nomenclatorial history discussed by Lindsey (1962. *J. Fish. Res. Board Can.* 19:687-714), who presented characters which clearly distinguish it from *C. clupeaformis*.



NT: Mackenzie Dist., Mackenzie River, Peel Channel, 343 mm SL (NMC).



DISTRIBUTION AND HABITAT: Common in rivers, lakes and brackish water primarily in Arctic drainages from Pechora River, USSR (excluding *C. nasus sensu in Europe*) east to AK and northwestern Canada to Perry River, NT, south to Kuskokwim River, AK, and Penzhina River, Sea of Okhotsk. Survived glaciation in Bering region. Inhabits muddy rivers and clear lakes and is anadromus in coastal areas. Cumbaa et al. (in prep.) report an Upper Pleistocene fossil from YT.

ADULT SIZE: 230-670 mm FL.

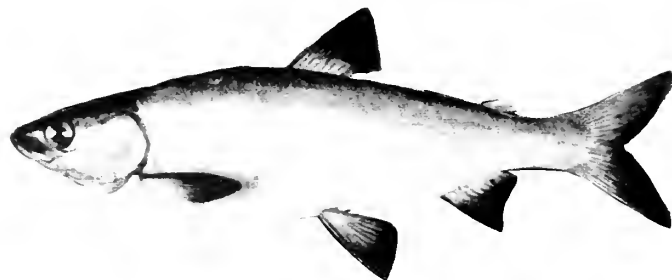
BIOLOGY: Not well known. Information on spawning, age and growth, feeding, and parasites summarized by McPhail and Lindsey (1970. *Freshwater Fishes of North-western Canada and Alaska*), Scott and Cross-

man (1973. *Freshwater Fishes of Canada*), Muth (1969. *J. Fish. Res. Board Can.* 26: 2252-56), and Hatfield et al. (1972. *Fish Resources of the Mackenzie River Valley*. Environ. Can. Fish. Serv. 2 vol.). Males develop white tubercles on scales and are heavier than females. In Arctic Red River area, lower Mackenzie, abundance increased from June to mid-September, and major run occurred in late October and early November. Spawning reported in August; eggs pale yellow. Food in fresh water consists of bottom organisms including insects (particularly chironomid pupae and corixids), small molluscs and crustaceans. Attains age of 18 years and weight of 5.5 kg in Canada.

Compiler: D. S. Lee and D. E. McAllister. August 1978.

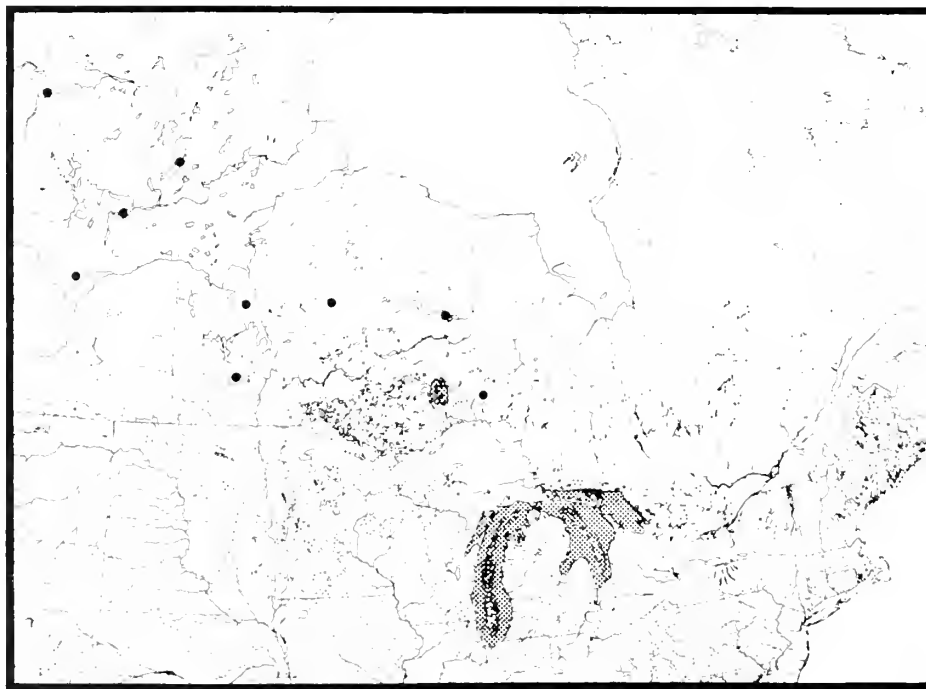
Coregonus nigripinnis (Gill)
Blackfin cisco

Order Salmoniformes
Family Salmonidae



WI: Lake Michigan, male,
(USFWS).

TYPE LOCALITY: Lake Michigan off Racine, WI (Gill in Hoy 1872. Trans. Wis. Acad. Sci. Arts Lett. [1870-72] 1:98-101).
SYSTEMATICS: Subgenus *Leucichthys*. Koelz (1929. Bull. U.S. Bur. Fish. [1927] 43:297-643) recognized four subspecies in Great Lakes basin: *C. n. nigripinnis* from lakes Michigan and Huron; *C. n. regalis* from Lake Nipigon; *C. n. cyanopterus* from Lake Superior; and *C. n. prognathus* from Lake Ontario. *Coregonus n. cyanopterus* is synonymous with *C. zenithicus* (Clarke 1973. Ph.D. diss., Univ. Manitoba; Todd and Smith, unpubl.) as may be *C. n. prognathus* (Clarke 1973). Populations of ciscoes from northwestern ON, MB, SA, and NT have been assigned to this species, but characteristics of *C. nigripinnis* outside Great Lakes basin merge with those of *C. artedii*, and it should be included with that species (Clarke 1973). Kooyman (1970. M.Sc. thesis, Univ. Calgary) also questioned validity of earlier identification of *C. nigripinnis* in Waskesiu Lake, SA.



DISTRIBUTION AND HABITAT: Formerly present in deep waters (90-160 m) of lakes Michigan and Huron and in much shallower water (2-100 m) in Lake Nipigon. Apparently only *C. n. regalis* of Lake Nipigon is extant; last known record of *C. n. "nigripinnis"* was from Lake Michigan in 1969. Map also shows records from central Canada now considered *C. artedii*.

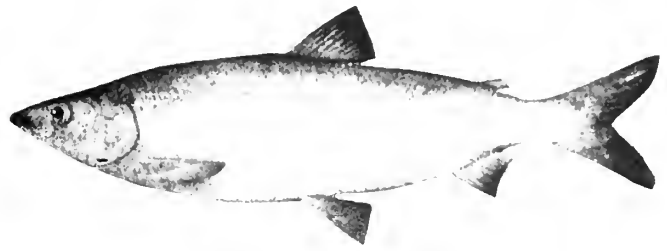
ADULT SIZE: 230-370 mm SL.

BIOLOGY: Summary provided by Scott and Crossman (1973. *Freshwater Fishes of Canada*). General ecology discussed by Koelz (1929). Apparently spawned from October to January in Great Lakes, possibly at 150 m over clay bottom. In Lake Huron, fed almost exclusively on *Mysis relicta*. Parasites discussed by Keleher (1952. J. Fish. Res. Board Can. 8:469-78). Decline in fishery reported by Smith (1964. Trans. Am. Fish. Soc. 93:155-63). Compiler: R. McV. Clarke and T. N. Todd. October 1978.

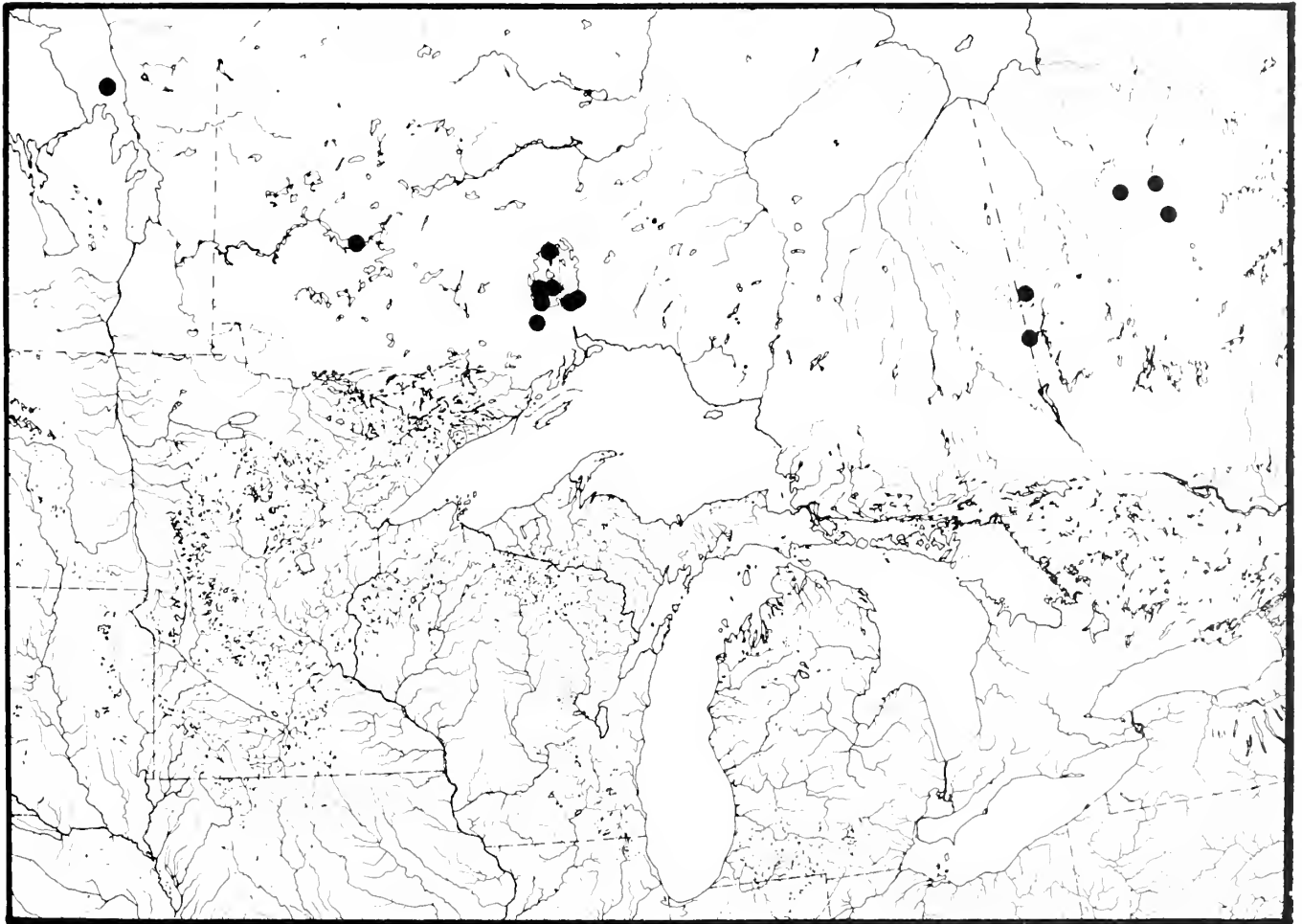
Coregonus nipigon (Koelz)
Nipigon cisco

Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lake Nipigon, ON, off MacDiarmid, at depth of 55 m (Koelz 1925. Occas. Pap. Mus. Zool. Univ. Mich. 158:1-3).
SYSTEMATICS: Subgenus *Leucichthys*. *Coregonus nipigon* has been distinguished from *C. artedii* by its higher number of gill-rakers (>54 or >56), but this and other characteristics merge with those of *C. artedii*. Consequently Scott and Crossman (1973. *Freshwater Fishes of Canada*) and Clarke (1973. Ph.D. diss., Univ. Manitoba, Winnipeg) regarded *C. nipigon* as junior synonym of *C. artedii*. This species is not recognized by the 1980 AFS checklist committee.



ON: Lake Nipigon, male
(USFWS).



DISTRIBUTION AND HABITAT: Cisco populations identified as *C. nipigon* occur in Lake Nipigon, in scattered lakes in northwestern QU and northwestern ON, and in Lake Winnipeg, MT. Occurs in shallower waters of lakes Nipigon and Winnipeg.

ADULT SIZE: 250-450 mm FL.

BIOLOGY: Little known. Distribution in Lake Nipigon described by Dymond (1926. Publ. Ont. Fish. Res. Lab. 27: 1-108). Growth

in Lake Winnipeg reported by Keleher (1952. J. Fish. Res. Board Can. 8:469-78) and in Waswanipi Lake, QU, by Magnin et al. (1973. Que. Serv. Faune Rapp. 8:13-42). In Lake Winnipeg feeds on plankton, spawns in November (Bajkov 1932. Contrib. Can. Biol. 7:325-33), and is significantly more infested with *Triacnophorus crassus* than other ciscoes (Keleher 1952).

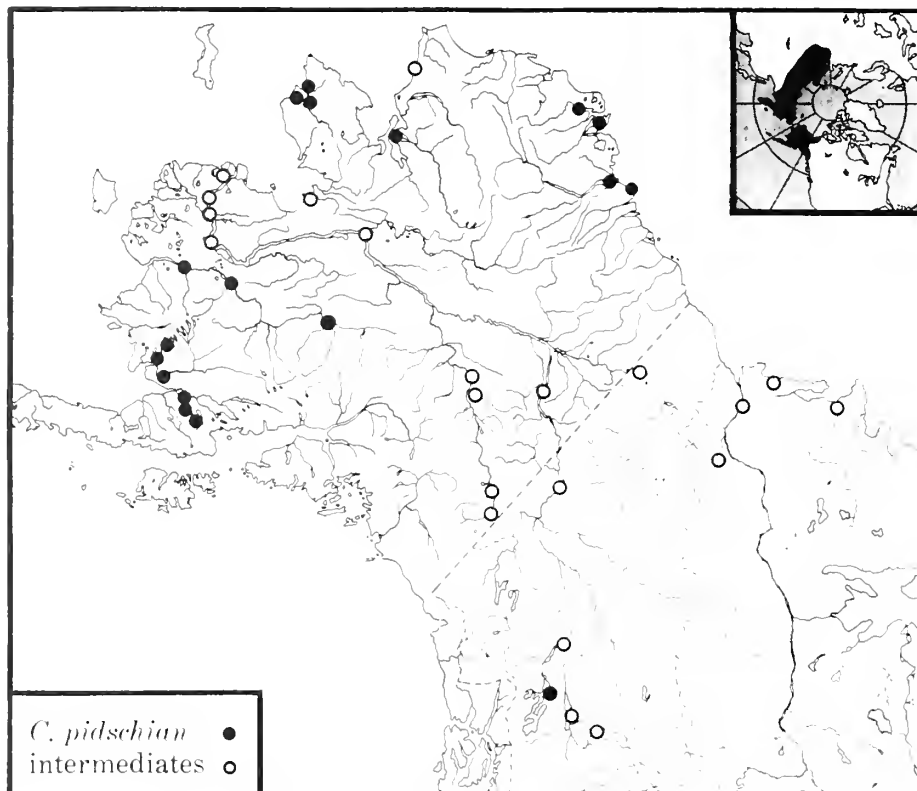
Compiler: R. McV. Clarke. October 1978.

TYPE LOCALITY: Ob River, Siberia, (Gmelin in Linnaeus 1788. *Systema naturae*, Laurentii Salvii, Holmiae, 13 ed., 1:1126-1516).

SYSTEMATICS: Cryptic member, of questionable status, of *C. clupeaformis* complex, with low modal gill raker counts (20-22, sometimes 23). McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*) discussed systematics of this and an intermediate form, "*C. nelsoni*", of uncertain relationship. Relationships between forms of this complex within and between Old World and New World are unresolved; present interpretations defy binomial nomenclature. This account included only to contribute to consistency with current AFS checklist.

ILLUSTRATION

NOT AVAILABLE



Map modified from McPhail and Lindsey 1970

DISTRIBUTION AND HABITAT: East across Arctic Siberia to at least Ob River, perhaps into eastern Europe, and in North America from Bristol Bay around to Arctic AK. Intermediate populations of uncertain origins in most of Yukon River, Paxson Lake, Copper River system, around parts of coastal AK, Anderson River, and Mackenzie River delta. Common in lakes, but also found in large rivers and brackish water.

ADULT SIZE: 200-400 mm FL.

BIOLOGY: Lindsey (1963. J. Fish. Board Can. 20:749-67) studied sympatric populations of two *Coregonus* species tentatively identified as *C. clupeaformis* and *C. pidschian* in Squanga Lake, YU. Latter form occupied bottom layers of lake and fed primarily on benthic organisms. Lindsey (1963) was unable to ascertain season and site of spawning.

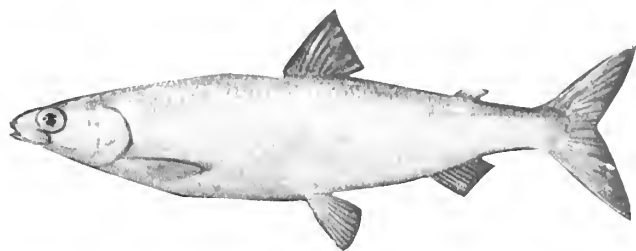
Compiler: D. S. Lee. November 1978.

***Coregonus reighardi* (Koelz)**
Shortnose cisco

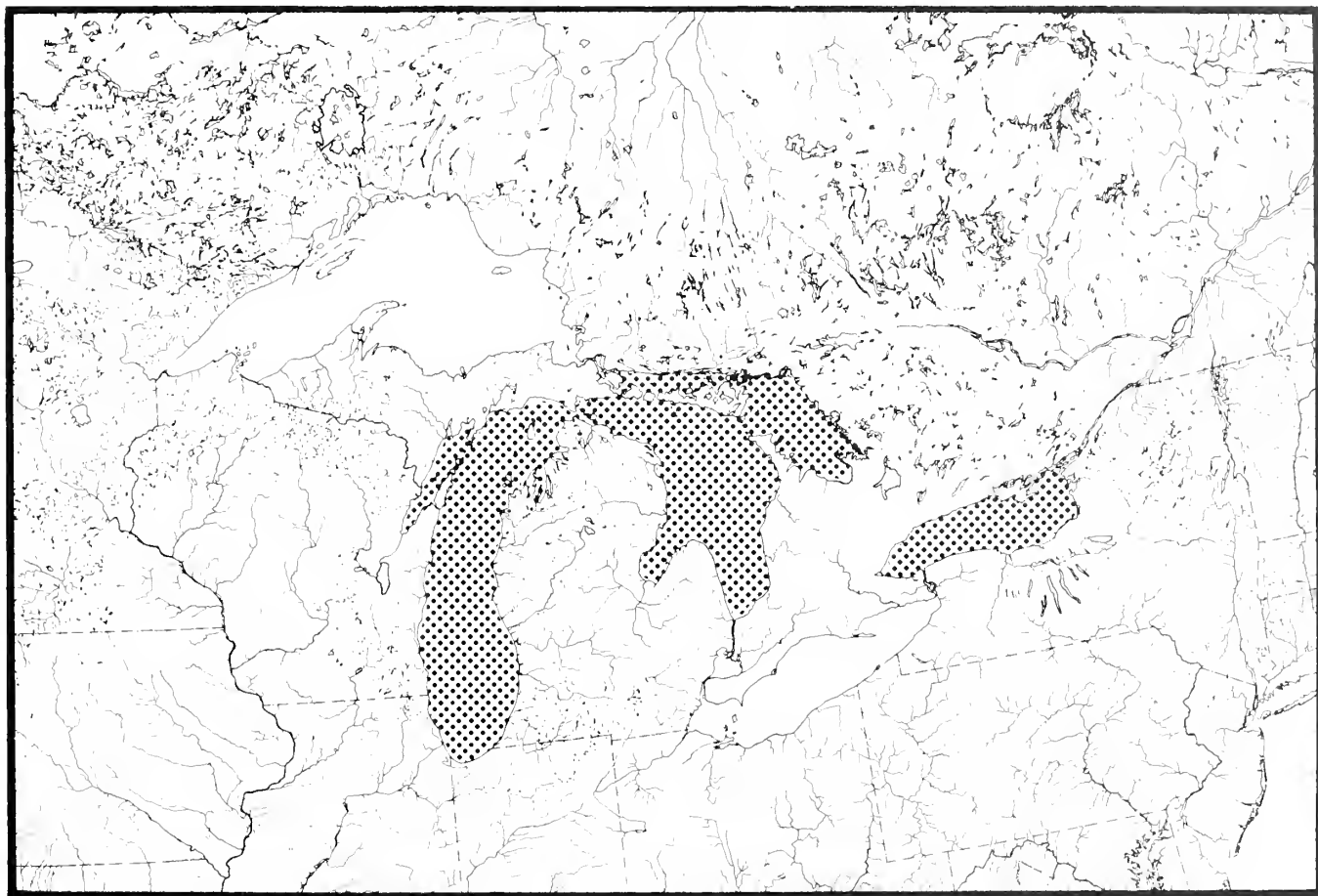
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lake Michigan, off Michigan City, IN (Koelz 1924. Occas. Pap. Mus. Zool. Univ. Mich. 146:1-8).

SYSTEMATICS: Subgenus *Leucichthys*. Two described subspecies *C. r. reighardi* of lakes Michigan, Huron, and Ontario, and *C. r. dymondi* of lakes Superior and Nipigon. Recent evidence (Todd and Smith, unpubl.) shows *C. r. dymondi* conspecific with *C. zenithicus*. Clarke (1973. Ph.D. diss., Univ. Manitoba) suggested *C. r. reighardi* conspecific with *C. zenithicus*.



IN: Lake Michigan, female,
(USFWS).



DISTRIBUTION AND HABITAT: Previously common in deep waters (10-160 m) of lakes Michigan, Huron, and Ontario. Populations in lakes Michigan and Ontario apparently extirpated, the last living specimens seen in 1972 and 1964, respectively, after many years of decline. Only extant *C. reighardi* occur in Georgian Bay, Lake Huron.

ADULT SIZE: 170-260 mm SL.

BIOLOGY: Summary provided by Scott and Crossman (1973. *Freshwater Fishes of Canada*). Ecology discussed by Koelz (1929. Bull.

U.S. Bur. Fish. [1927] 43:297-643), Pritchard (1931. Pub. Ontario Fish Res. Lab. 41: 1-78), and Jobes (1943. Trans. Am. Fish. Soc. 72:108-35). Hoffman (1967. *Parasites of North American Freshwater Fishes*) reported on parasites. Food is almost entirely *Mysis relicta* and *Pontoporeia affinis*. Changes in fishery reported by Smith (1964. Trans. Am. Fish. Soc. 93:155-63). Spawning took place in May-June and *C. reighardi* was the only species in lakes Michigan, Huron, and Ontario which spawned in spring.

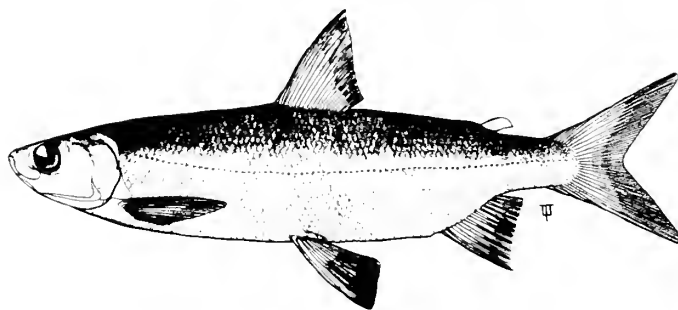
Compiler: T. N. Todd. October 1978.

Coregonus sardinella Valenciennes
Least cisco

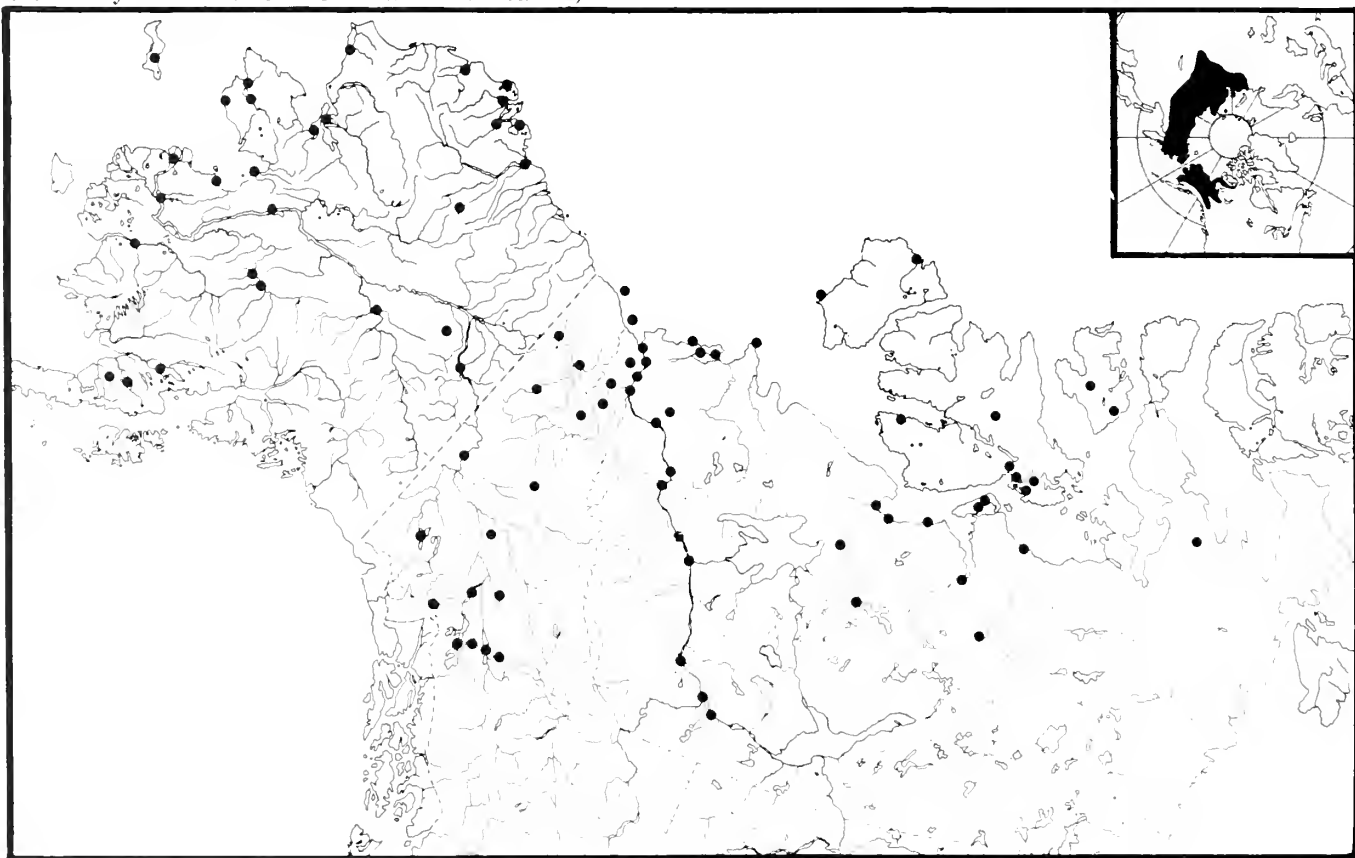
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Irtysk and Kolyma rivers, Siberia, USSR (Valenciennes in Cuvier and Valenciennes 1848. *Histoire Naturelle des Poissons* 21:1-536).

SYSTEMATICS: Subgenus *Leucichthys*. Considered in Europe to be subspecies of *C. albula* (Behnke 1972. J. Fish. Res. Board Can. 29:639-71). In North America *C. sardinella* constitutes a species complex with migratory and non-migratory forms and a third form in Naknek and Iliamna Lakes, AK (McPhail and Lindsey 1970. *Freshwater Fishes of Northwestern Canada and Alaska*).



NT: Mackenzie Dist.,
Mackenzie River, Peel
Channel, 234 mm SL (NMC).



DISTRIBUTION AND HABITAT: Anadromous populations in Arctic coastal waters, and estuaries and rivers draining into Arctic Ocean and Bering Sea in Russia, Siberia, AK, and Canada. In North America occurs from Bristol Bay, AK, to Murchison River, NT, ascending Yukon River to Circle and Mackenzie River to Fort Simpson. Non-migratory forms occur in large lakes and rivers in upper Yukon River system and in lakes in Bristol Bay area.

BIOLOGY: Summarized by McPhail and Lindsey (1970) and Scott and Crossman (1973. *Freshwater Fishes of Canada*). Spawns in autumn over sand and gravel in shallow water. Anadromous forms move upstream from the sea in summer and downstream after spawning, although some populations overwinter in fresh water. Along the Beaufort Sea coast it feeds on amphipods, mysids, and insects (Percy 1975. Beaufort Sea Tech. Rep. 8:1-114), but migratory form apparently does not feed during spawning migrations. Non-migratory form feeds on plankton and insect larvae.

ADULT SIZE: 150-420 mm FL.

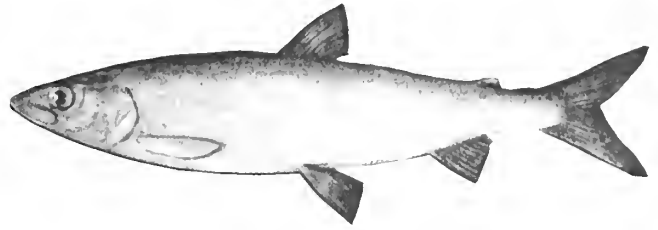
Compiler: R. McV. Clarke. October 1978.

***Coregonus zenithicus* (Jordan and
Evermann)**
Shortjaw cisco

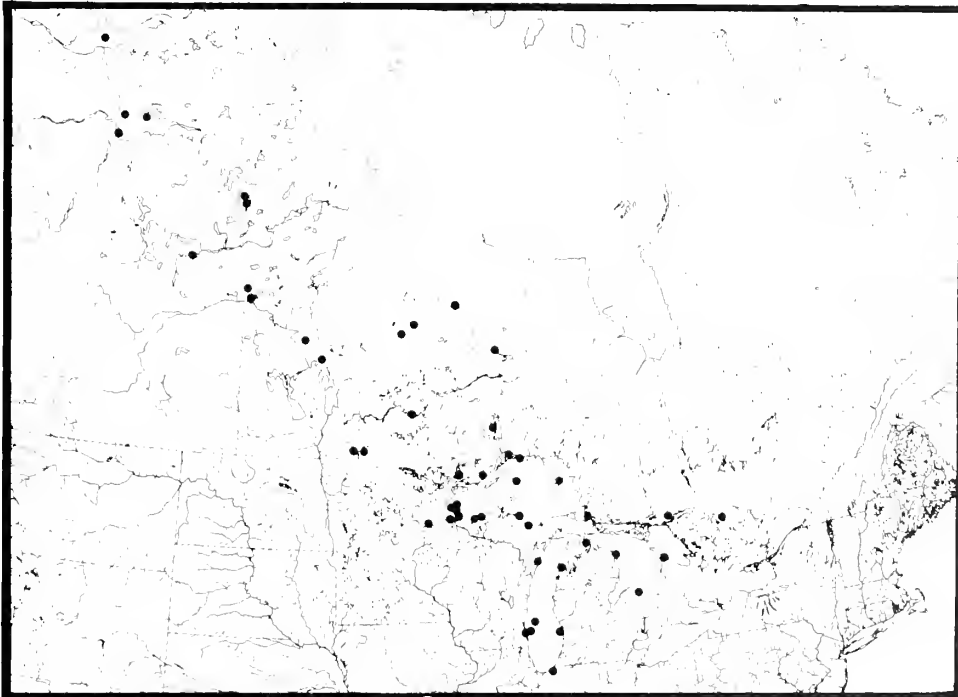
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lake Superior in deep water off Isle Royale (Jordan and Evermann 1909. Proc. U.S. Natl. Mus. 36:165-72).

SYSTEMATICS: Subgenus *Leucichthys*. Conspecific with *C. alpenae* (Todd and Smith, unpubl.), with *C. nigripinnis cyanopterus* and *C. reighardi dymondi* (Clarke 1973. Ph.D. diss., Univ. Manitoba; Todd and Smith, unpubl.), and perhaps with *C. n. prognathus* and *C. r. reighardi* (Clarke 1973). Very similar to *C. johannae*. Although *C. zenithicus* was readily recognizable in Great Lakes, occurrence elsewhere viewed with doubt (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Considering ciscoes outside Great Lakes drainage, Clarke (1973) proposed *C. zenithicus* is valid species distinguished from *C. artedii* primarily by fewer gillrakers, and includes some ciscoes previously identified as *C. artedii* and *C. hoyi* but excludes one population previously identified as *C. zenithicus*.



WI: Lake Superior, male
(USFWS).



DISTRIBUTION AND HABITAT: Previously common in 20-180 m of water in the Great Lakes, except possibly Lake Ontario, but now only lakes Superior and Nipigon appear to have extant populations. Single specimen taken in 1975 in Lake Michigan, only one in nearly ten years of repeated sampling. Occurs northwest to Great Slave Lake, NT, generally in deeper lakes.

ADULT SIZE: 100-400 mm SL.

BIOLOGY: Summarized by Scott and Crossman (1973). Koelz (1929. Bull. U.S. Bur. Fish. [1927] 43:297-643) described many aspects of life history. Van Oosten (1937. Pap. Mich. Acad. Sci. Arts Lett. [1936] 22:691-711) reported on age and growth. Parasites

reported by Hoffman (1967. *Parasites of North American Freshwater Fishes*) and Keleher (1952. J. Fish. Res. Board Can. 8: 469-78). There are sympatric and allopatric populations with variations in morphology and spawning time (Clarke 1973; Todd and Smith, unpubl.). In Lake Athapapuskow, MB, growth, food and vertical distribution differed significantly from those of *C. artedii* (Clarke 1970. M.Sc. thesis, Univ. Manitoba). Normally smaller than sympatric *C. artedii*, but in Barrow Lake, AT, is larger (Paterson 1969. J. Fish. Res. Board Can. 26:1934-39).

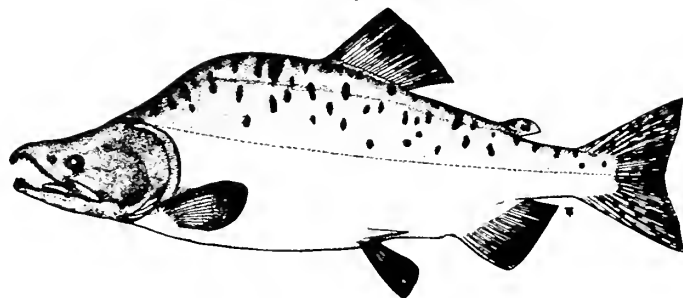
Compilers: R. McV. Clarke and T. N. Todd.
October 1978.

***Oncorhynchus gorbuscha* (Walbaum)**
Pink salmon

Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Rivers of Kamchatka, USSR (Walbaum in Artdi 1772. *Genera Piscium* 3:4-723).

SYSTEMATICS: Essentially unstudied, apart from Rounsefell's (1962. Fishery Bull. 62:237-70) work on relationships between *Oncorhynchus* species. Vladykov (1962. Bull. Fish. Res. Board Can. 136:1-172) compared pyloric caeca in specimens from North America and Japan. Taxonomic comparisons between even and odd year stocks seem warranted.



ca. 53 cm SL (NMC).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Pacific and Arctic oceans, Bering and Okhotsk seas, and Sea of Japan. Young and spawning adults known from most tributary rivers of northeast Asia, and in North America from Sacramento River, CA, north throughout Aleutian Islands to Mackenzie River delta. Small introduced population maintains itself in western Lake Superior and in NF. Also introduced into Europe. Anadromous.

ADULT SIZE: 400-610 mm TL.

BIOLOGY: Neave (1966. Int. North Pac. Fish. Comm. Bull. 18:81-85), Aro and Shepard (1967. Int. North Pac. Fish. Comm. Bull. 23:225-327), and Scott and Crossman (1973. *Freshwater Fishes of Canada*) provided life history summaries.

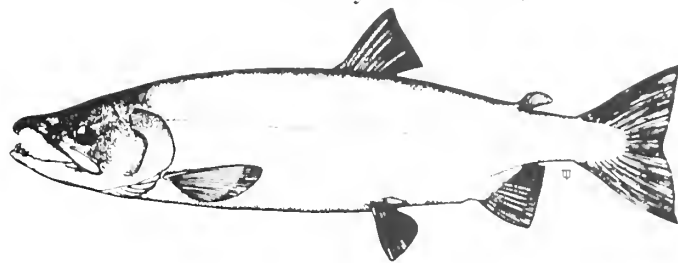
Compilers: D. S. Lee. and J. R. Shute. July 1978.

***Oncorhynchus keta* (Walbaum)**
Chum salmon

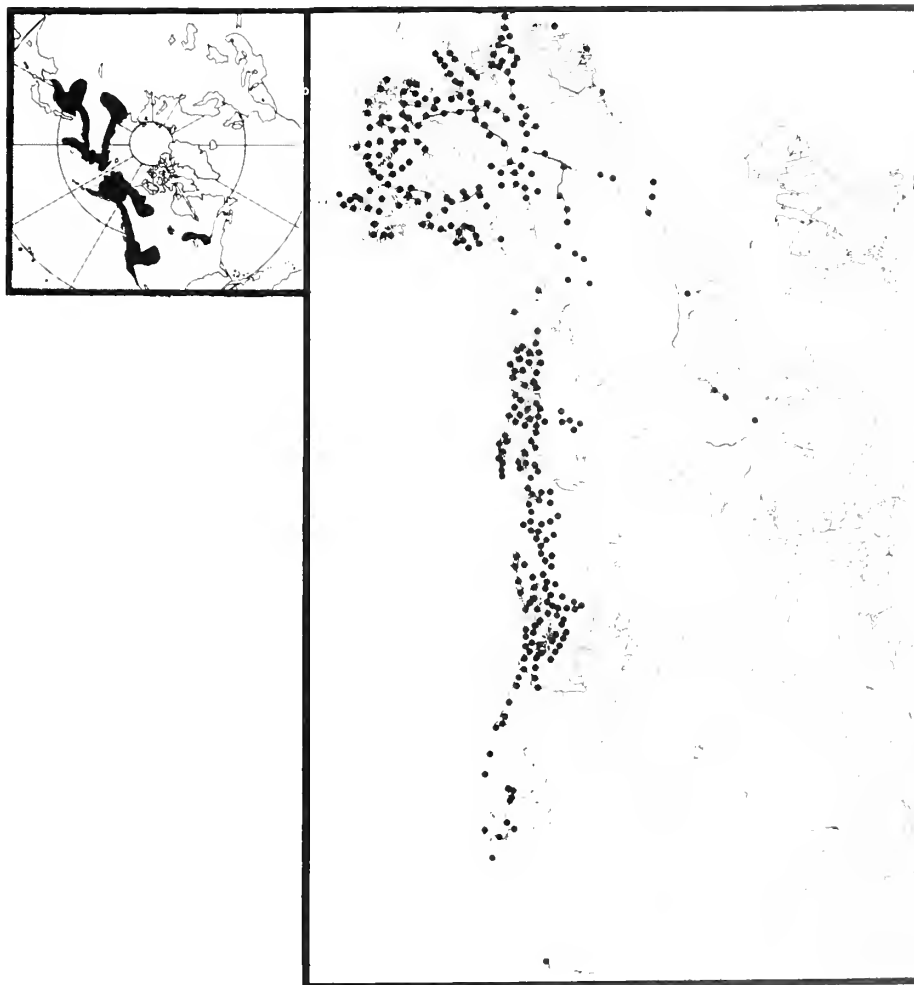
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Rivers of Kamchatka, USSR (Walbaum in Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Essentially unstudied apart from Rounsefell's (1962. Fishery Bull. 62:237-70) work on relationships between *Oncorhynchus* species. Vladykov (1962. Bull. Fish. Res. Board Can. 136:1-172) compared pyloric caeca in specimens from North America and Japan.



ca. 64.5 cm SL (NMC).



DISTRIBUTION AND HABITAT: Adults found in Pacific and Arctic oceans, Sea of Japan, and Okhotsk and Bering seas. In North America spawning runs occur from San Lorenzo River, CA, to northwest AK, and east to Peel, Mackenzie, and perhaps Anderson rivers. Transplanting efforts outside natural range unsuccessful. Anadromous, with some spawning runs extending considerable distance upstream (up to 2,000 km) in rivers lacking major barriers.

ADULT SIZE: 48-80 cm SL, 100 cm maximum.

BIOLOGY: Summaries of most aspects of life history provided by Neave (1966. Int. North Pac. Fish. Comm. Bull. 18:81-85), Hallock and Fry (1967. Calif. Fish. Game 53:5-22), McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*), Scott and Crossman (1973. *Freshwater Fishes of Canada*), and Moyle (1976. *Inland Fishes of California*).

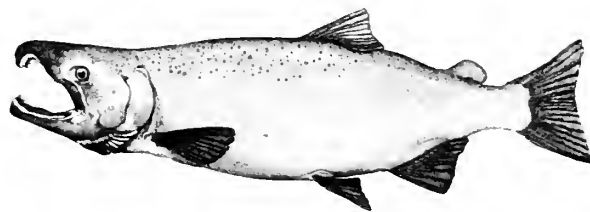
Compilers: D. S. Lee and J. R. Shute.
July 1978.

Oncorhynchus kisutch (Walbaum)
Coho salmon

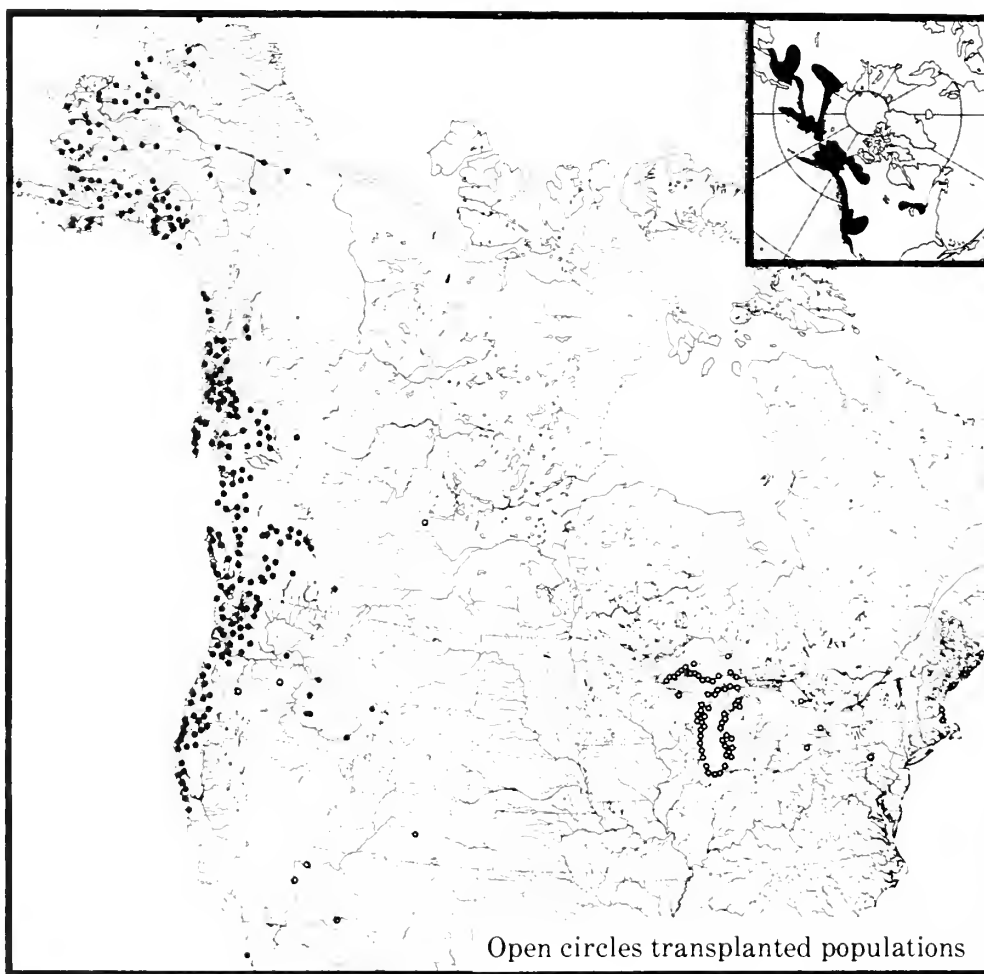
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Rivers and lakes of Kamchatka, USSR (Walbaum *in* Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Range of meristic variation fairly uniform throughout natural distributional range. Scott and Crossman (1973. *Freshwater Fishes of Canada*) discussed meristics of transplanted populations in Great Lakes area.



BC: male, 51 cm SL. (Moyle 1976).



DISTRIBUTION AND HABITAT: Naturally occurring in Pacific Ocean and tributary drainages from Anadyr River south to northern Japan and from Point Hope, AK, south to Monterey Bay, CA. Has been infrequently reported at sea as far south as Baja California. Widely stocked in freshwater lakes (CA, AK, OR, WA, MT, ME, LA, MD, Great Lakes, AT, Argentina, and Chile). Most transplants unsuccessful, and with few exceptions populations maintained only by repeated stocking. Possible natural reproduction in MI. Anadromous, usually not traveling more than 241 km from the sea in large rivers.

ADULT SIZE: 450-610 mm SL.

BIOLOGY: Shapovalov and Taft (1954. Calif. Dept. Fish Game Bull. 98:1-375) extensively studied a population in Santa Cruz Co., CA. Summaries of most aspects of life history provided by McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*), Scott and Crossman (1973), Fry (1973. *Anadromous Fishes of California*), and Moyle (1976. *Inland Fishes of California*).

Compilers: D.S. Lee and J.R. Shute. July 1978.

Oncorhynchus nerka (Walbaum)
Sockeye salmon

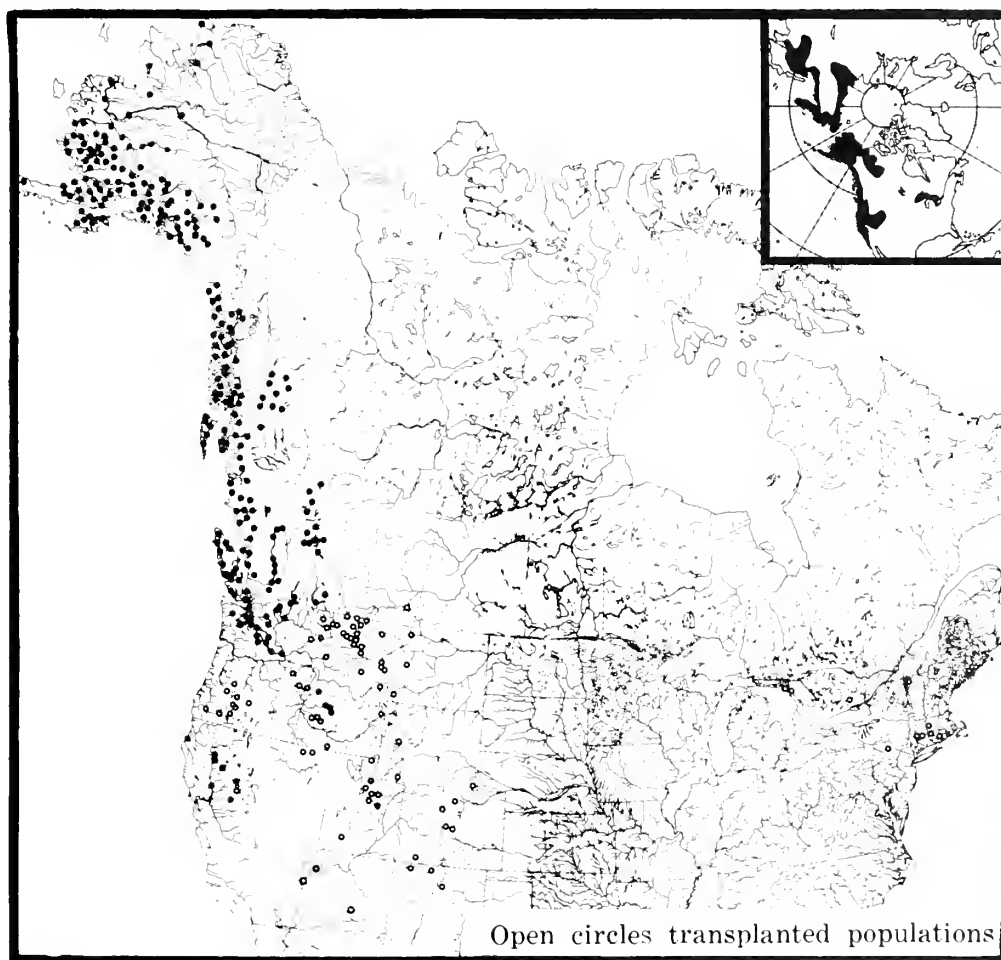
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Rivers and seas of Kamchatka, USSR (Walbaum *in* Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Non-anadromous (kokanee) and anadromous (sockeye) forms frequently considered different subspecies. Intermediate form (residual sockeye) also known (Ricker 1938. *J. Fish. Res. Board Can.* 4:192-218) and, since freshwater forms apparently evolved independently, seems little need to continue subspecific recognition (McPhail and Lindsey 1970. *Freshwater Fishes of Northwestern Canada and Alaska*).



BC: male, 49 cm SL (Moyle 1976).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Freshwater lake populations occur naturally in Japan, USSR, AK, WA, ID, OR, YU, and BC. Anadromous forms in Asia from Hokkaido, Japan, to Anadyr River, USSR, and in North America from Sacramento River, CA, north to Point Hope, AK. Stocked widely in northern North America, but few successful transplants.

ADULT SIZE: Freshwater populations 160-279 mm FL; anadromous populations 610-711 mm FL.

BIOLOGY: Foerster (1968. *Bull. Fish. Res. Board Can.* 162:1-422), Ricker (1966. *Int. North Pac. Fish. Comm. Bull.* 18:59-70), McCannon (*in* Calhoun [ed.] 1966. *Inland Fisheries Management*), Scott and Crossman (1973. *Freshwater Fishes of Canada*) and Moyle (1976. *Inland Fishes of California*) discussed biology of non-anadromous forms.

Compilers: D. S. Lee and J. R. Shute.
July 1978.

Oncorhynchus tshawytscha (Walbaum)
Chinook salmon

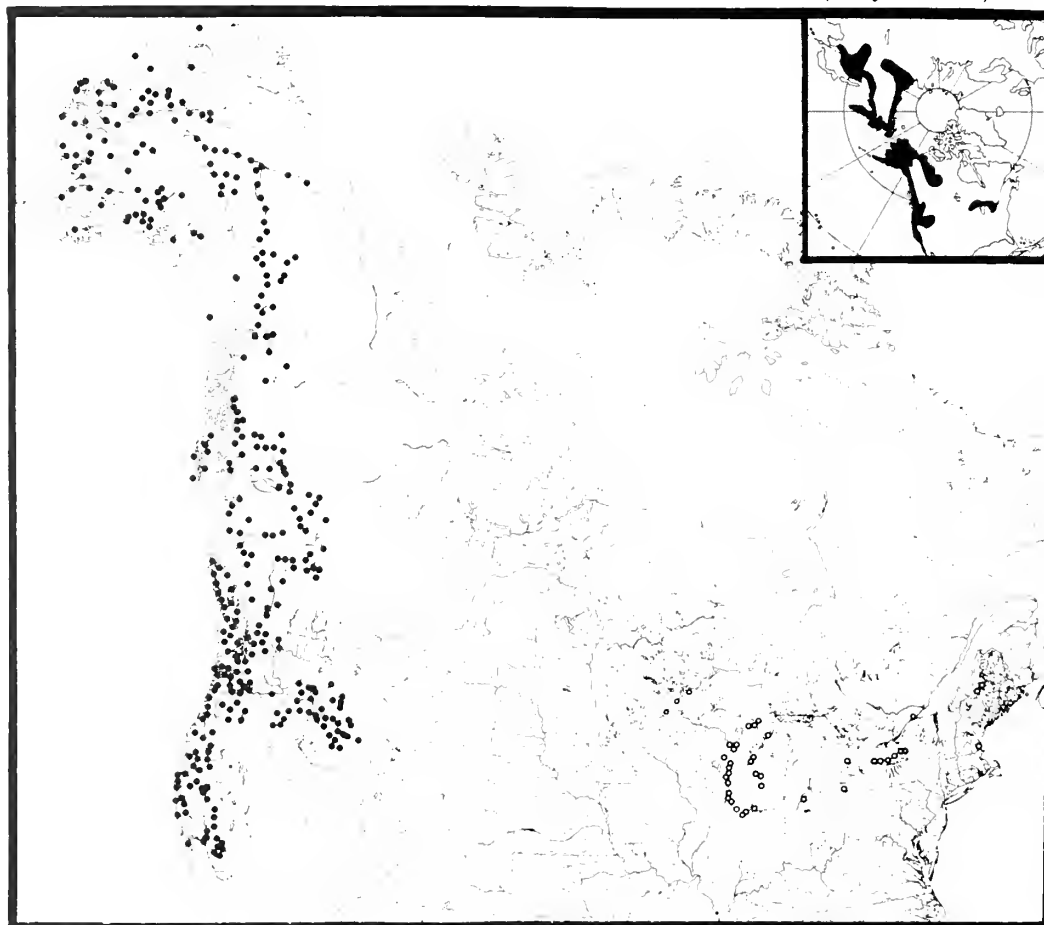
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Rivers of Kamchatka, USSR (Walbaum in Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Broad meristic variation within species, but individual stocks usually uniform. Scott and Crossman (1973. *Freshwater Fishes of Canada*) provided comparison of variation between Pacific and introduced Lake Ontario populations.



CA: Sacramento Co., American River, male, 64 cm SL (Moyle 1976).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Originally in Pacific Ocean and tributary drainages in Asia from northern Japan to Anadyr River, USSR, and North America from Ventura River, CA north to Point Hope, AK. Southernmost runs in CA extirpated. Numerous attempts made to transplant populations in various parts of world, but apparently only permanently successful stockings occurred in New Zealand and perhaps Great Lakes. Anadromous, often migrating considerable distances upstream. Least abundant of Pacific salmon.

ADULT SIZE: 75-80 cm SL.

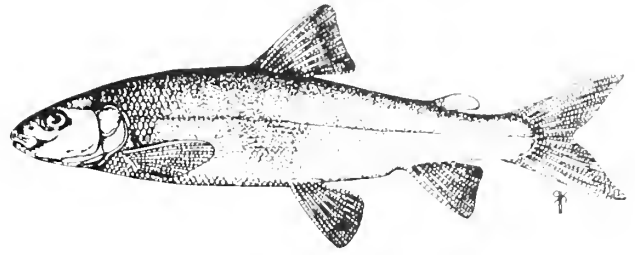
BIOLOGY: Life history highly variable and many rivers have more than one stock. Reimers (1973. Res. Depts. Oreg. Fish Comm. 4:1-43) recognized five major life history strategies among stocks of fall-spawning Chinook salmon in Sixes River, OR. Mason (1965. Int. North Pac. Fish. Comm. Bull. 16:41-73) and Aro and Shepard (1967. Int. North Pac. Fish. Comm. Bull. 23:225-327) provided information on biology. Summaries in McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*), Scott and Crossman (1973), and Moyle (1976. *Inland Fishes of California*).
Compilers: D. S. Lee and J. R. Shute. July 1978.

***Prosopium abyssicola* (Snyder)**
Bear Lake whitefish

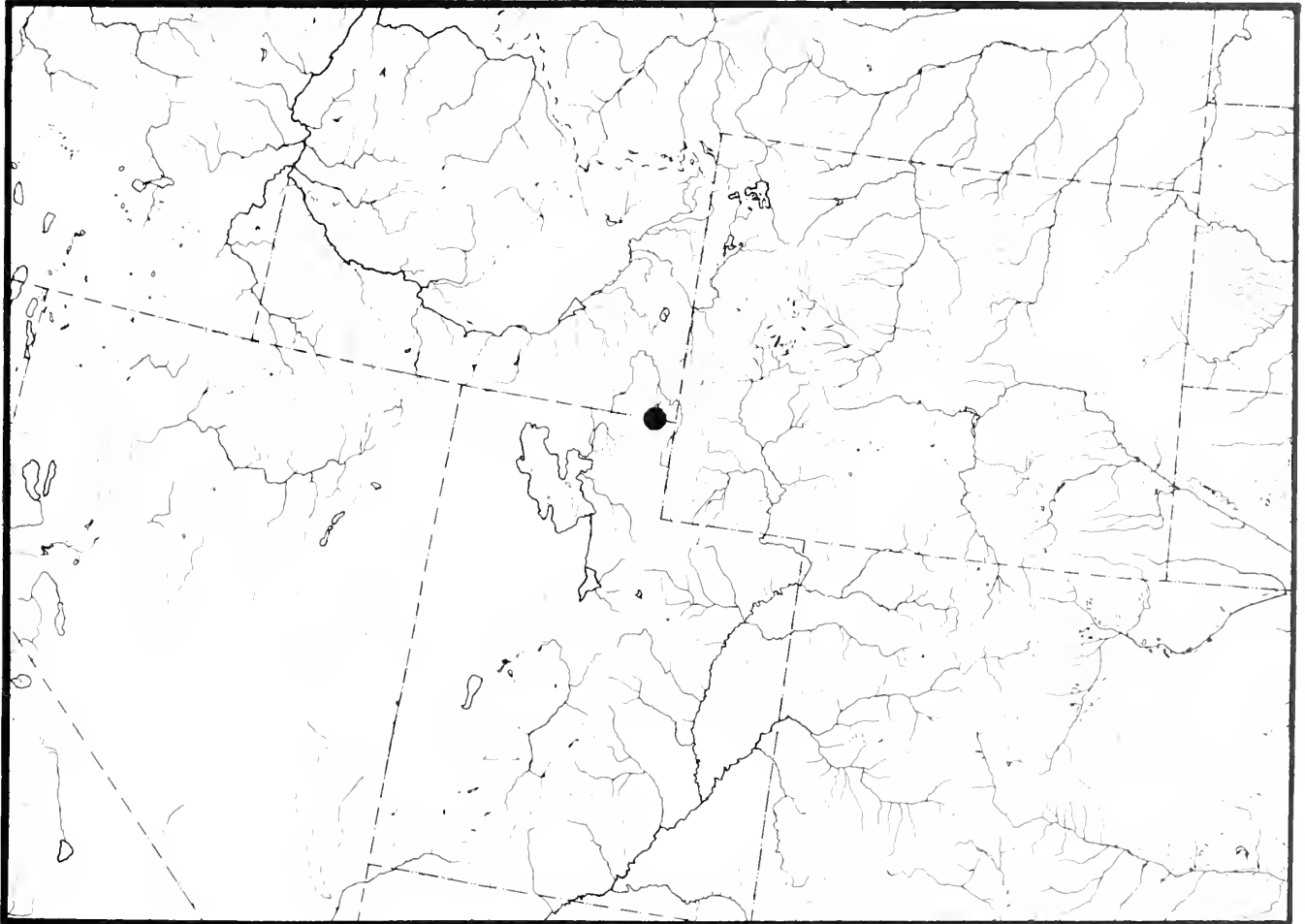
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Bear Lake near Fish Haven, ID (Snyder 1919. U.S. Bur. Fish. [1917-18] 36:1-9).

SYSTEMATICS: Appears to have evolved from *P. williamsoni*-like ancestor (Norden in Lindsey and Woods 1970. *Biology of Coregonid Fishes*).



(NCSM)



DISTRIBUTION AND HABITAT: Confined to Bear Lake, UT and ID. Usually in deeper waters although may occur at any depth depending upon environmental conditions. In general in deeper water and less abundant than *P. spilonotus*, one of two other Bear Lake endemics.

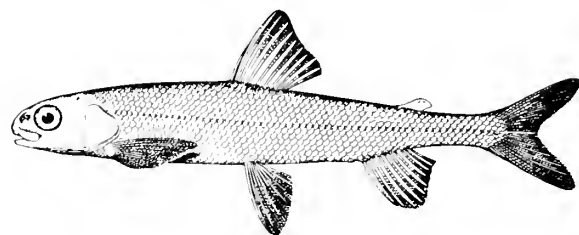
BIOLOGY: Sigler and Miller (1963. *Fishes of Utah*) summarized biology. Spawns mostly in January or February, sometimes into March. Ostracods, midge larvae, and oligochaetes are principal food items. Eight age classes present.

ADULT SIZE: ca. 130-170 mm SL.

Compiler: F. C. Rohde, February 1978.

Prosopium coulteri (Eigenmann and Eigenmann)
Pygmy whitefish

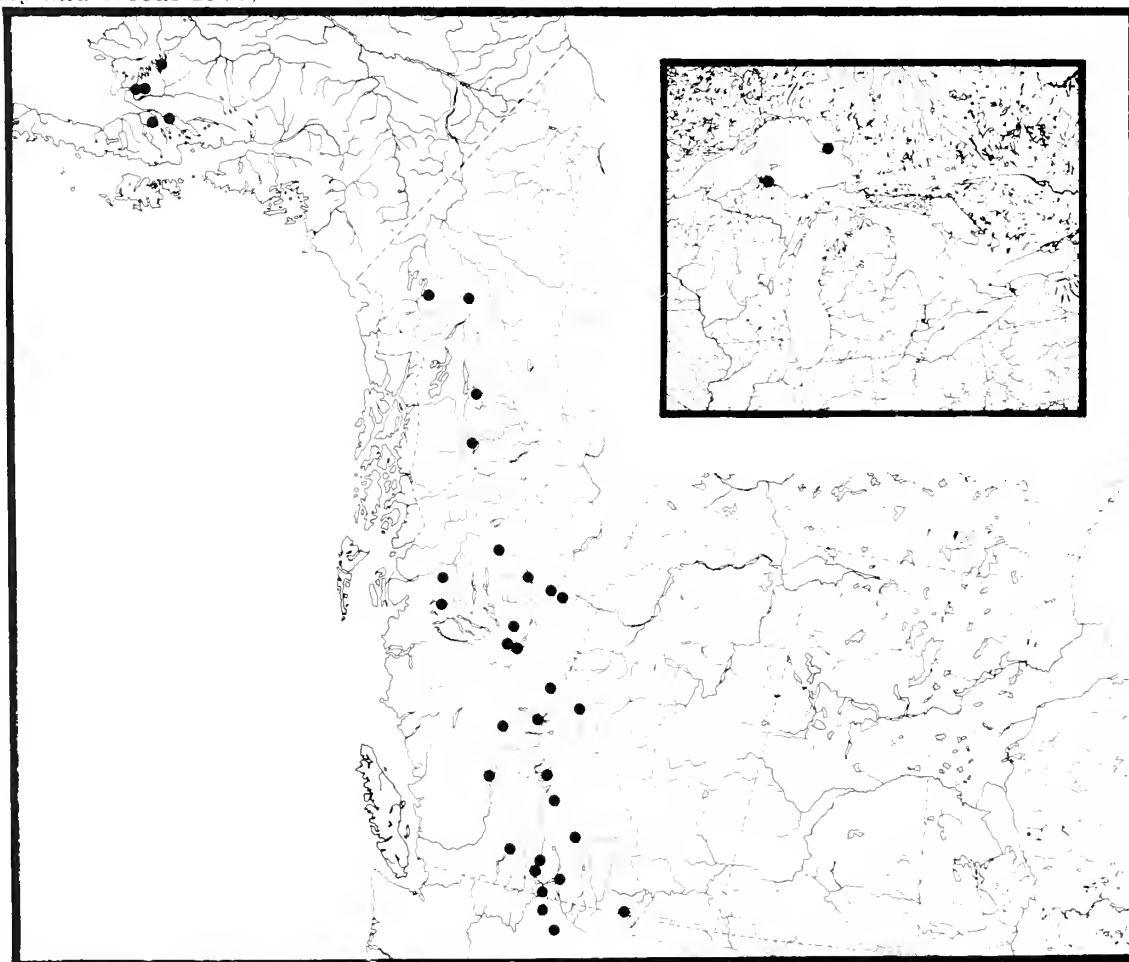
Order Salmoniformes
Family Salmonidae



TYPE LOCALITY: Kicking Horse River, at Field, BC (Eigenmann and Eigenmann 1892. Am. Nat. 26:961-63).

SYSTEMATICS: Thought to represent early offshoot from ancestral type (Norden in Lindsey and Woods 1970. *Biology of Coregonid Fishes*). Systematics reviewed by Eschmeyer and Bailey (1955. Trans. Am. Fish. Soc. 84: 161-99) and McCart (in Lindsey and Woods 1970). Distinctive sibling populations of *P. coulteri* (with differing morphological and ecological characteristics) known from each of at least three Alaskan lakes (McCart in Lindsey and Woods 1970).

BC: Kicking Horse River at Field (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Unique disjunct distribution, due in part to post-glacial dispersion. In east found only in Lake Superior, in west, from Columbia River system in western MT and WA to southwestern AK. Common in lakes and flowing waters of clear or silted rivers of mountainous country. In Lake Superior found in depths from 18.3-88.6 m. In western lakes lives in waters usually less than 6 m, not changing depth distribution seasonally.

ADULT SIZE: 102-127 mm TL, 271 mm FL maximum.

BIOLOGY: Spawns October to December over coarse gravel in shallow waters of streams or lakes. Females lay average of between 440 and 580 eggs, varying geographically. Eggs ca. 22 mm diameter. Adaptable feeder, consuming crustaceans, chironomids, ostracods, *Pontoporeia*, copepods, and fish eggs. Preyed upon by kingfishers (Snyder 1917. Copeia: 93-94) and terns, *Sterna paradisaea* (Heard and Hartman 1966. U.S. Fish Wildl. Serv. Fish. Bull. 65:555-79).

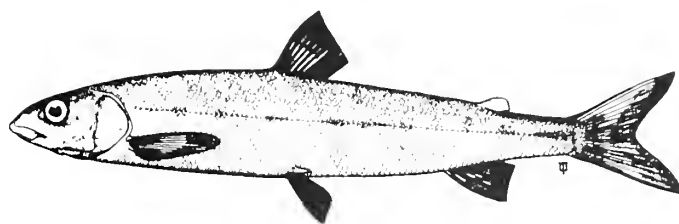
Compiler: F. C. Rohde and S. P. Platania. February 1978.

Prosopium cylindraceum (Pallas)
Round whitefish

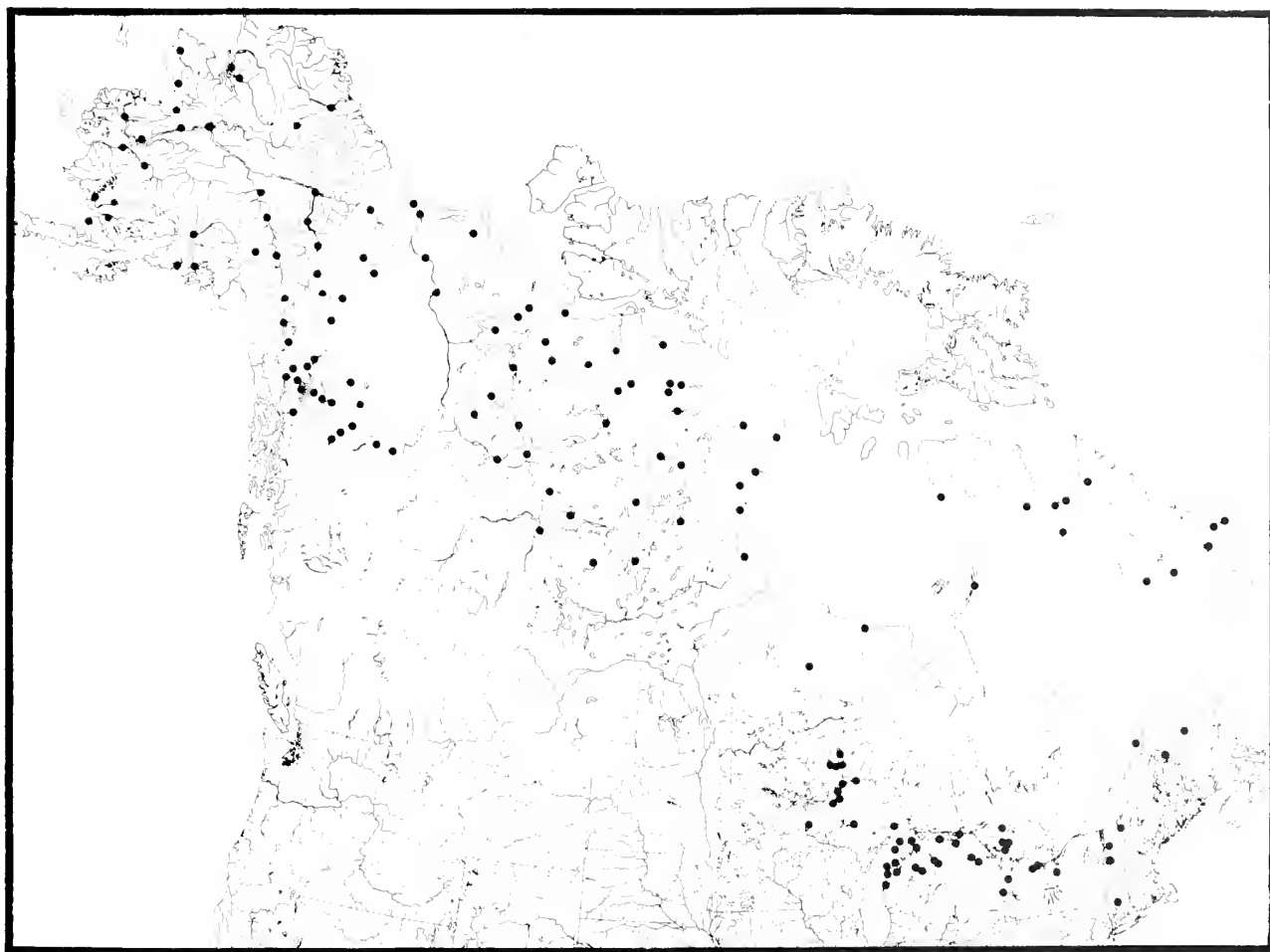
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lena, Kowyma, and Indigirska rivers (Pallas in Pennant 1784. *Arctic Zoology* Vol. 1).

SYSTEMATICS: Diverged more recently from ancestral *Prosopium* than have *P. coulteri* and *P. williamsoni* (Norden in Lindsey and Woods 1970. *Biology of Coregonid Fishes*). McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*) remarked on possibility of two morphological types.



QU: Lake Canichico (NMC).



DISTRIBUTION AND HABITAT: Northern North America, from CT to Labrador in east to AK in the northwest. Discontinuous in general region of ON-MB border. Usually in deep lakes to the south and rivers or streams to the north.

BIOLOGY: Scott and Crossman (1973. *Freshwater Fishes of Canada*) summarized data on spawning, fecundity, age and growth, food habits, predation, and parasites. Also see Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) for additional details.

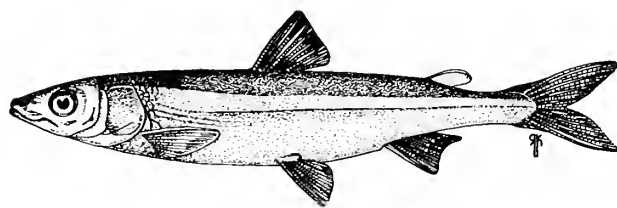
ADULT SIZE: 203-305 mm TL.

Compiler: F. C. Rohde. February 1978.

Prosopium gemmiferum (Snyder)
Bonneville cisco

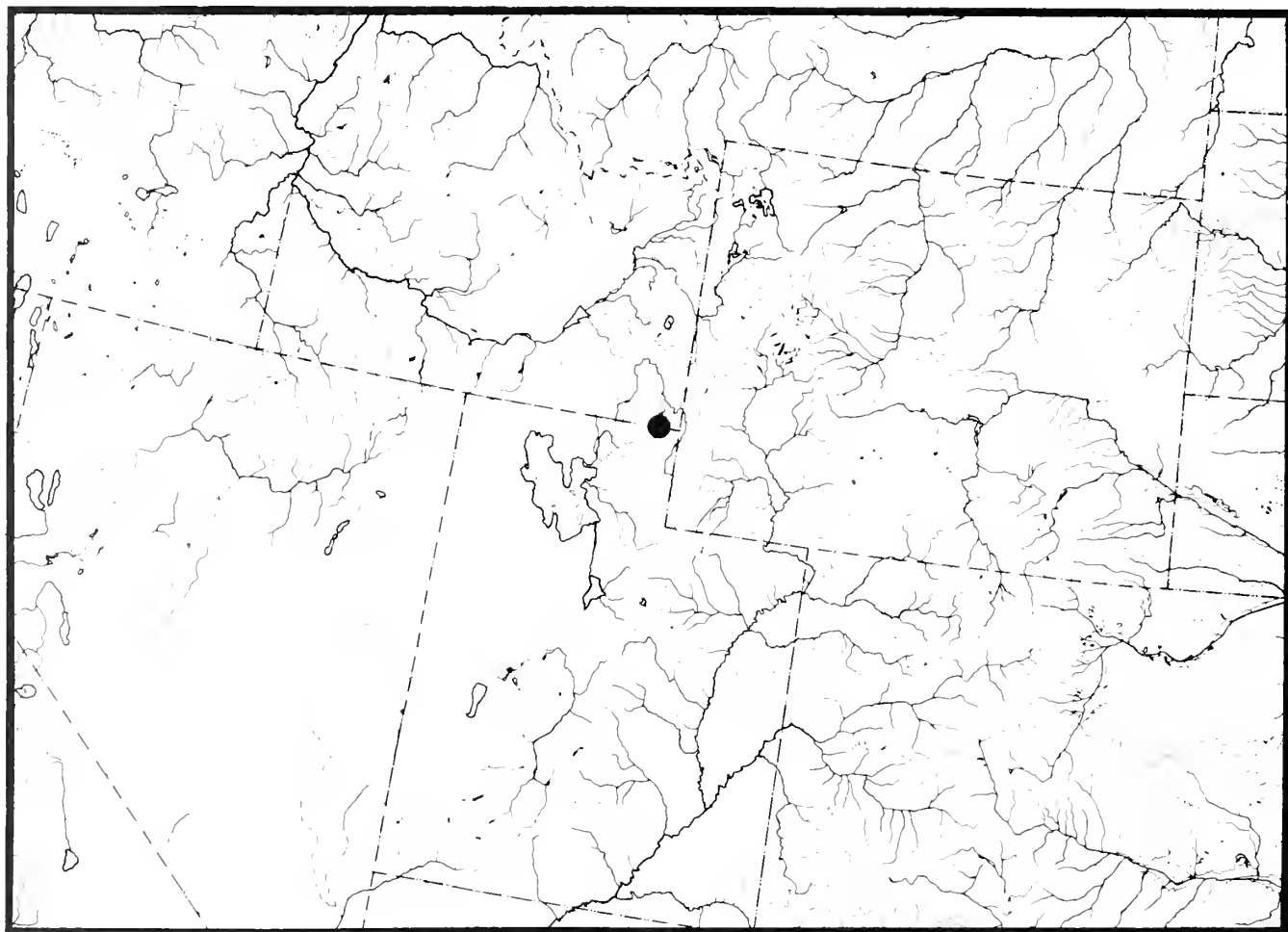
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Bear Lake, near Fish Haven, ID (Snyder 1919. U. S. Bur. Fish. Bull. [1917-18] 36:1-10).



(NCSM)

SYSTEMATICS: Most highly specialized member of genus *Prosopium*. Exhibits adaptation for planktonic feeding similar to that of subgenus *Leucichthys* (Norden in Lindsey and Woods 1970. *Biology of Coregonid Fishes*).



DISTRIBUTION AND HABITAT: Endemic to Bear Lake, UT and ID, where apparently not rare. Sigler and Miller (1963. *Fishes of Utah*) reported occurrence on or near bottom at temperatures of approximately 3.9°C (in summer this may be as deep as 18.3-30.5m). Perry (1943. M.Sc. thesis, Utah State Univ.) found it distributed throughout all depths at certain seasons of year.

BIOLOGY: Sigler and Miller (1963) summarized biology. Lives at least six years, maturing during second or third year. Spawns in January or early February, mostly in water 20 to 50 cm deep (occasionally as deep as 9.3 m). Feeds mostly on four small crustacean species and occasionally on insects.

ADULT SIZE: 140-196 mm TL.

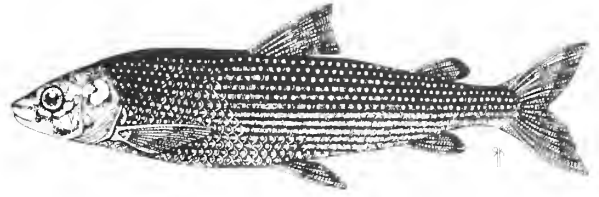
Compilers: F. C. Rohde and C. R. Gilbert.
July 1978.

Prosopium spilonotus (Snyder)
Bonneville whitefish

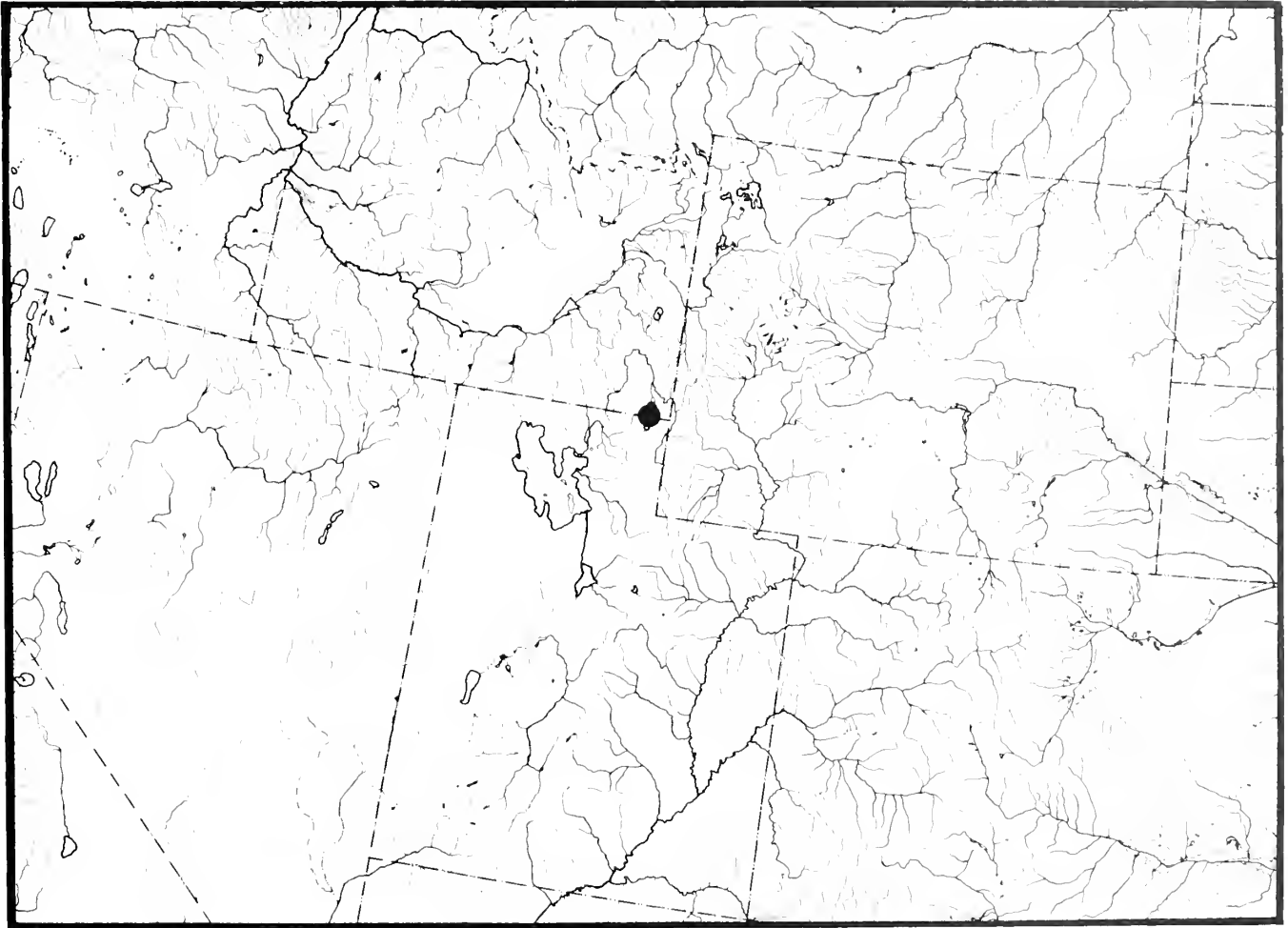
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Bear Lake, near Fish Haven, ID (Snyder 1919. Bull. U.S. Bur. Fish. [1917-18] 36:1-9).

SYSTEMATICS: Very similar to both *P. abyssicola* and *P. williamsoni* and apparently derived from latter.



(NCSM)



DISTRIBUTION AND HABITAT: Confined to Bear Lake, UT-ID. Found in all depths; frequently moves into shallow water, but most often at depths of 12-30 m.

BIOLOGY: McConnell et al. (1957. Utah Dept. Fish Game Publ.:1-76) and Sigler and Miller (1963. *Fishes of Utah*) summarized biological data. Eight age groups found. Reaches spawning size (203 mm) during third or fourth years. Spawns mid-November to early January on rocky shoals, or sandy point in relatively shallow water, at about 7°C. Egg number ranges from 600 to at least 1200. Food consists mostly of chironomid larvae and pupae (McConnell et al. 1957).

ADULT SIZE: 417 mm TL maximum.

Compiler: F. C. Rohde. February 1978.

Prosopium williamsoni (Girard)
Mountain whitefish

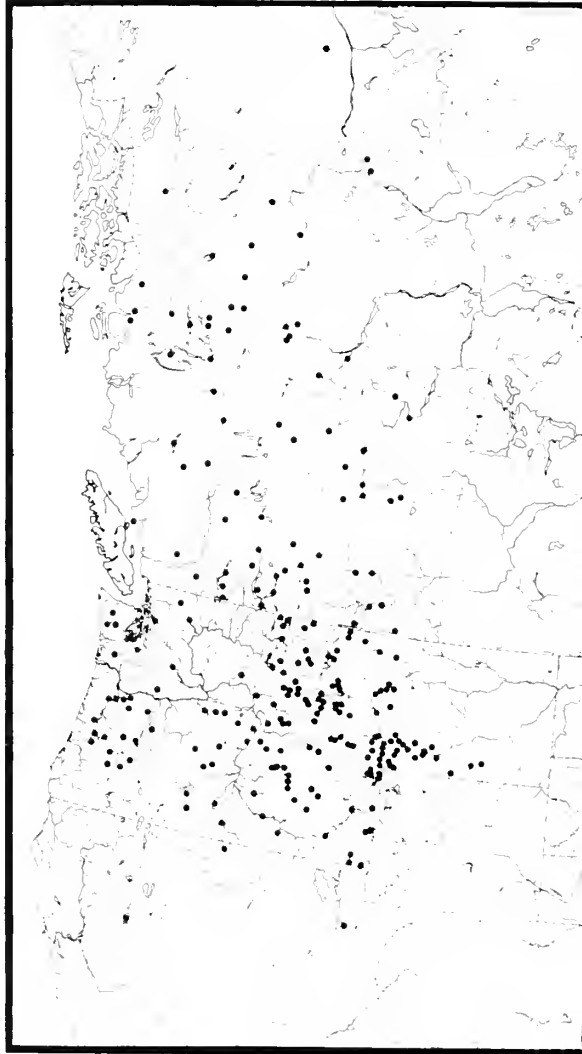
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Deschutes River, tributary to Columbia River, OR (Girard 1856. Proc. Acad. Nat. Sci. Phila. 8:131-38).

SYSTEMATICS: Believed to occupy position close to ancestral *Prosopium* stem (Norden in Lindsey and Woods 1970. *The Biology of Coregonid Fishes*). Apparently *P. oregonium* is junior synonym of this species (Holt 1960. *Copeia*:192-200).



CA: Placer Co., Sagehen Creek,
28 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Lakes and streams of western North America from Lahontan basin, NV, to YU-BC border (Scott and Crossman 1973. *Freshwater Fishes of Canada*).

BIOLOGY: Scott and Crossman (1973) summarized data on spawning, fecundity, age and growth, food habits, predation, and parasites. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) supplied additional details on age and growth.

ADULT SIZE: 200-572 mm TL.

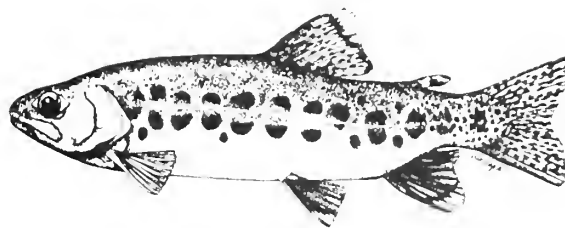
Compiler: F. C. Rohde. February 1978.

***Salmo aguabonita* Jordan**
Golden trout

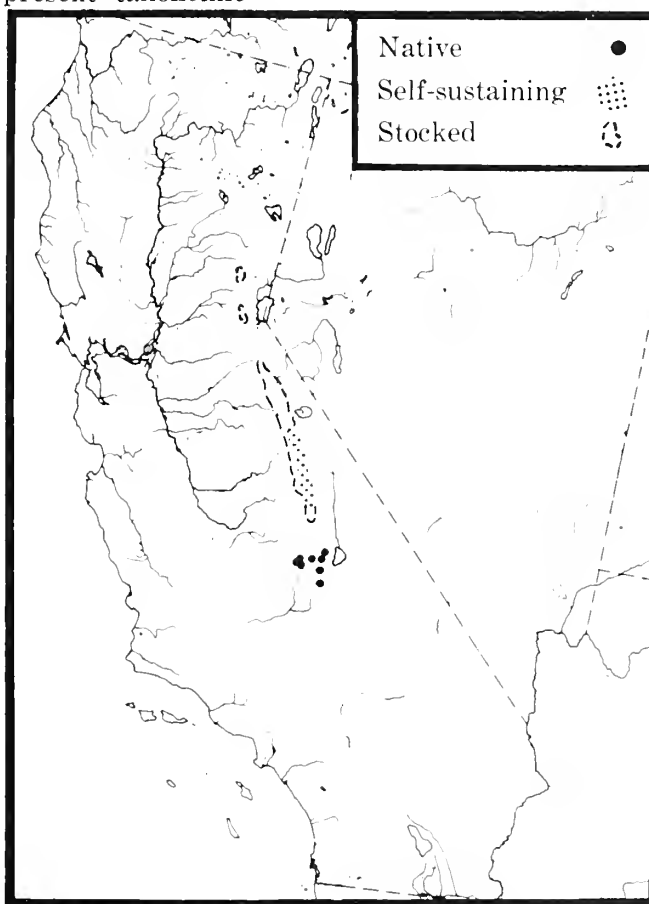
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Cottonwood Cr., CA (Jordan 1892. Bienn. Rep. State Board Fish. Comm. Calif. [1891-92]:62-65). Based on introduction from South Fork of Kern basin, CA.

SYSTEMATICS: Schreck and Behnke (1971. J. Fish. Res. Board Can. 28:987-98) reviewed systematics of upper Kern River basin *Salmo*, and provided information on meristic characters for various populations. Two subspecies, *S. a. aguabonita* and *S. a. gilberti*, recognized. Authors stated that most trout in basin are hybrids of recent origin and that pure populations are limited to head-water areas. Moyle (1976. *Inland Fishes of California*) summarized present taxonomic status.



CA : Fresno Co., Clarence Lake,
18 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Endemic to clear, cool waters of upper Kern basin, Tulare and Kern cos., CA, at elevations above 2,100 m. *Salmo a. aguabonita* confined to south fork of Kern River and Golden Trout Creek, *S. a. gilberti* only from Main Kern and Little Kern. Although precise historic downstream distribution unknown, area where South Fork joins Kern is "warm" water habitat, which apparently served as barrier between two subspecies. Numerous transplants to other areas have occurred, but distribution of stocked populations cannot be stated with any accuracy since most populations have hybridized with cutthroat and

rainbow trout.

ADULT SIZE: ca. 165-430 mm FL, 710 mm TL maximum.

BIOLOGY: Feeds primarily on aquatic insects. Lives 6-7 years. Spawns in gravel riffles at temperatures of 7°-10° C, usually in late June or July. Despite publicity received by species, few life history studies undertaken other than those of Curtis (1934, Trans. Am. Fish. Soc. 64:259-65) and Needham and Vestal (1938, Calif. Fish Game 24:273-79). Moyle (1976) summarized known information.

Compiler: R. J. Behnke. May 1979.

Salmo apache Miller
Arizona trout

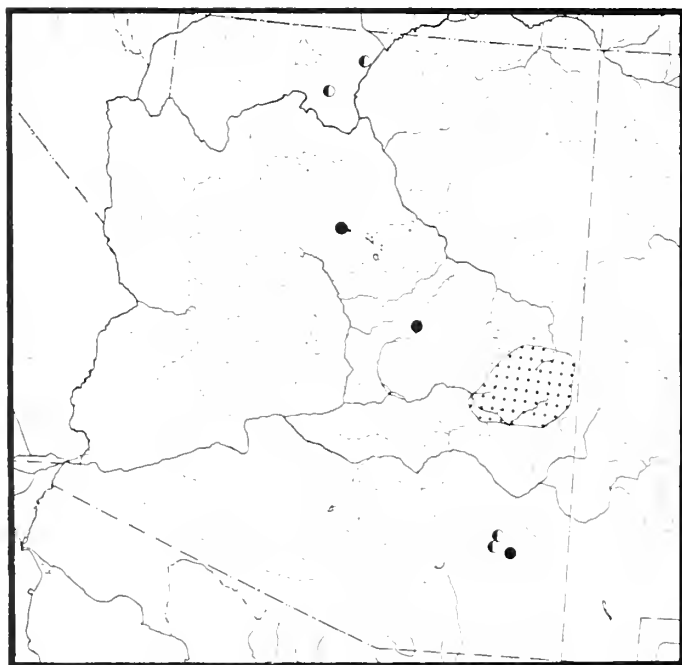
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: East Fork of White River at Kinney lookout trail crossing to 3 km upstream, 25 airline km ene of Fort Apache (T5N, R25E, Secs. 4-6 and T6N, R25E, Sec. 32) Apache Co., AZ (Miller 1972. Copeia: 401-22).

SYSTEMATICS: Subgenus *Parasalmo*. Relationships unclear (Miller 1972; Gold 1977. Can. J. Zool. 55:1858-73). First recorded from White River, AZ (Cope and Yarrow 1875. Rep. Geog. Geol. Explor. Surv. W. 100th Merid. [Wheeler Surv.] 5:635-703) and referred to as variety of cutthroat trout. Related to cutthroat (Miller 1972); Minckley (1973. *Fishes of Arizona*) interprets it as distinct line of *Salmo* that occurs in AZ, NM, and Mexico. Considered tentatively as Gila trout (Miller 1950. Occas. Pap. Mus. Zool. Univ. Mich. 529:1-42). Behnke and Zarn (1976. For. Serv. Gen. Tech. Rept. RM-28, Fort Collins, CO: 1-45) regarded it as most similar to that species.



AZ: Apache Co., East Fork of White River, 145 mm SL (J. N. Rinne).



Introduced populations outside native range: ●

DISTRIBUTION AND HABITAT: Historically in upper Salt River (Black and White rivers) and headwaters of Little Colorado River. Now occurs naturally primarily in small montane streams and cienegas in headwaters (2500+m) of Black and White river drainages (map). Hybridization with rainbow trout (Behnke and Zarn 1976) and competitive interaction with brook and brown trouts (Rinne et al., in press) have resulted in 95% (stream km) reduction in range (Harper in J. R. Moring [ed.] 1978. Proc. Wild Trout-Catchable Trout Symp., Ore. Dept. Fish Wildl., Eugene, OR:99-111). Stippled map area largely reflects localities in Arizona State Univ. records and results of recent (1977-78) survey work. Analysis of samples from survey indicated only 25% of 35 streams sampled contained pure populations of *S. apache*. Another 25% were problematic and half of populations impure (Rinne in prep.) Introduced into several streams in Pinaleno

Mountains, Graham Co., AZ (Carufel and Callon 1965. Wildl. Views 12:10-13) and North Canyon, Canyon, and Tapeats creeks, Coconino Co., AZ. Also several introduced lake populations (Rinne et al. in prep.). Once classified as endangered by USFWS but downlisted to threatened status in 1975 (Fed. Reg. 40[188]:44423).

ADULT SIZE: Streams, 100-140 mm SL; Lakes, 300-400 mm SL.

BIOLOGY: Harper (1978) studied biology of Big Bonita Creek population on Fort Apache Indian Reservation. Mature in three years (108-120 mm SL), spawn in May (~8°C). Hatch at 30 days, emerge at 20-25 mm SL in 60 days and display downstream nocturnal migration. Alcorn (1976) reported fish stopped feeding at 20°C; lost equilibrium at 21-22°C, and died at 23°C.

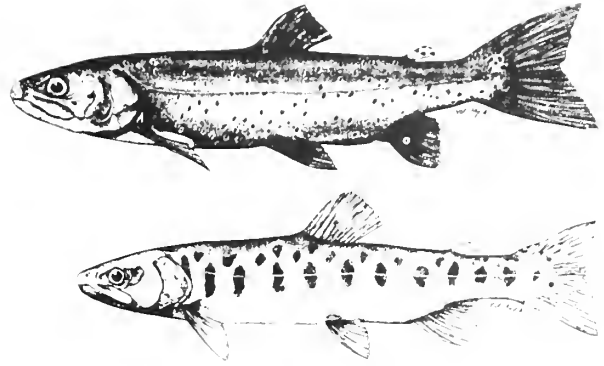
Compiler: J. N. Rinne. March 1979.

Salmo clarki Richardson
Cutthroat trout

Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Cathlapoot River (reputedly now North Fork of Lewis River), WA. (Richardson 1836. *Fauna Boreali-Americana*).

SYSTEMATICS: Most primitive member of subgenus *Parasalmo*. Coastal and interior forms once recognized as separate species. Recognition of native populations and analyzing taxonomy of this polytypic species greatly hampered by indiscriminant stocking. Behnke (in prep.) reviews complex mosaic of 15 subspecies, four unnamed. Although not all forms warrant names on taxonomic basis, these names are useful in recognizing specific populations for fish culture and providing protection from continued introductions into areas where native stocks persist. Known to hybridize with rainbow and golden trouts.



CA: (upper) Trinity Co.,
Granite Lake, 25 cm SL;
(lower) Alpine Co., Silver
King Creek, 16 cm SL
(Moyle 1976).



DISTRIBUTION AND HABITAT: Greatest distribution of any western trout. On coast, anadromous forms known from Eel River, CA, north to Prince William Sound, AK. Normally occurs less than 161 km inland; farthest penetration is headwaters of Skeena River, BC. Non-migrating stocks also occur throughout this range. Allopatric inland forms range from AT south through CA to NM and east to CO, MT, and AT. Widely stocked within and outside original range, and now present in many formerly trout-barren waters, mostly mountain lakes. Established in Laurentian lakes, QU, in 1940's. Formerly abundant in small rivers,

gravelly streams, isolated alpine lakes, and estuaries. Non-anadromous forms more restricted to headwaters than are rainbow trout.

ADULT SIZE: 300 - 485 mm TL; 990 mm TL maximum.

BIOLOGY: Useful summaries of nearly all aspects of biology available in Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), Scott and Crossman (1973. *Freshwater Fishes of Canada*), Moyle (1976. *Inland Fishes of California*), and Behnke (in prep.).

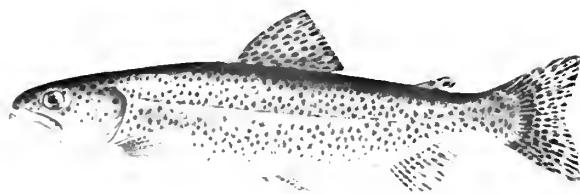
Compiler: R. J. Behnke. January 1979.

Salmo gairdneri Richardson
Rainbow trout

Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Mouth of Columbia River at Fort Vancouver, WA (Richardson 1836. *Fauna Boreali-Americana*).

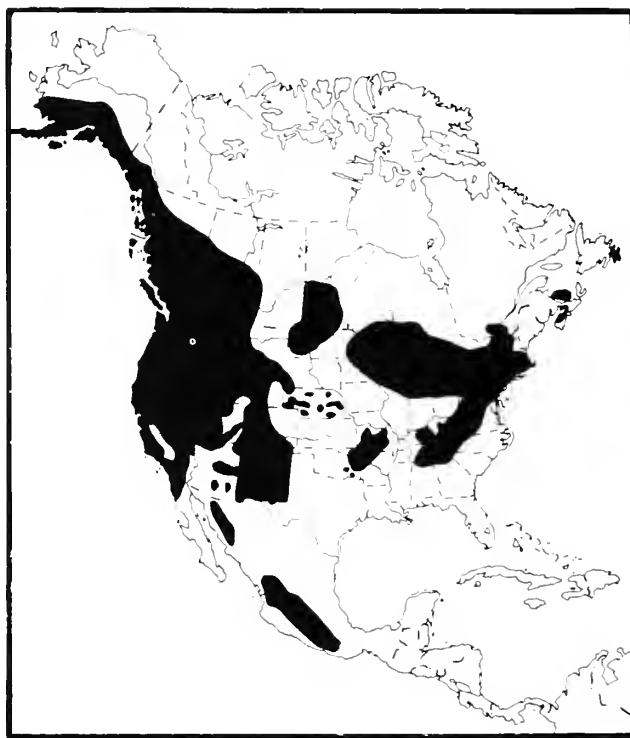
SYSTEMATICS: The "rainbow trout" is comprised of two major groups, coastal rainbow trouts and redband trouts. The redband trout, native to headwaters of McCloud River, CA, is closely related to the golden trout of Kern River drainage, CA, *S. aguabonita*. Oldest name for any member of redband trout group is *S. newberryi*. Oldest name applied to any member of either group is *S. mykiss*, proposed by Walbaum in 1792 for the Kamchatkan trout. Many practical difficulties are involved if *gairdneri* becomes synonym of *mykiss*.



(N.C. Wildl. Resour. Comm.
and NCSM)



Former Distribution



Present Distribution

DISTRIBUTION AND HABITAT: *Salmo mykiss* occurs in Asia north from Amur River in Othotsk Sea basin, and on Kamchatka and Commander Islands. *Salmo gairdneri* group in North America ranges from Kuskokwim River, AK, to Rio del Presidio, Durango, Mexico. Interior distribution includes headwaters of Fraser River, BC, Columbia River basin to major barrier falls on Kootenay, Pend Oreille, Spokane, and Snake rivers; native to several desiccating basins of southern OR and a few headwater areas of Mackenzie River basin, Canada. "Kamloops" trout of BC considered to be redband trout. Anadromous ("steelhead") and resident redband trout occur east of Cascade Mountains in Columbia basin. Except for northern and

southern extremes of range, anadromous populations occur in all coastal rivers. Resident stocks may inhabit small headwater streams or large rivers. There are several lacustrine specialized populations, especially in upper Columbia basin, and upper Fraser basin, BC ("Kamloops" trout). Widely introduced and established in suitable cold water habitats all over world.

ADULT SIZE: 250-750 mm TL; 1000 mm TL maximum.

BIOLOGY: As with cutthroat trout.

Compiler: R. J. Behnke, January 1979.

Salmo gilae Miller
Gila trout

Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Main Diamond Creek, ca. 53 km ese Beaverhead, T11S, R10W, Gila National Forest, Sierra Co., NM (Miller 1950. Occas. Pap. Mus. Zool. Univ. Mich. 529:1-42).

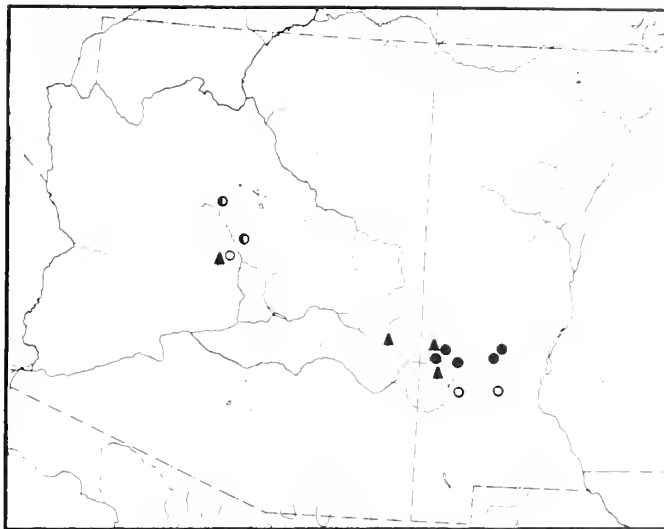


NM: Grant Co., McKnight Creek, 169 mm SL (J. N. Rinne).

SYSTEMATICS: Subgenus *Parasalmo*. Relationships considered by Miller (1972. Copeia:401-22) and Gold (1977. Can. J. Zool. 55:1858-73). Closely related to cutthroat and rainbow trout (Miller 1972) and readily hybridizes with latter (David 1976. M.S. thesis, New Mexico State Univ.). Karyotype (Beamish and Miller 1977. J. Fish. Res. Board Can. 34:1041-45) suggested close relationship to *S. apache*.

DISTRIBUTION AND HABITAT: Adequate information lacking to accurately define historical distribution (Behnke and Zarn 1976. USDA For. Serv. Gen. Tech. Rept. RM-28, Fort Collins:1-45), which may have included Verde and Agua Fria river drainages (AZ). Specimens collected by Snyder (1915. Proc. U.S. Natl. Mus. 49:573-86) from Oak and West Clears creeks identified as most similar to *S. gilae* (Miller 1972). Represented presently by an introduced population (Gap Creek) in Verde River drainage and a hybridized population (Sycamore Creek) in the Agua Fria (Behnke and Zarn 1976). Extant naturally in only five upper elevation (above 2,000 m) streams in Gila River headwaters in NM, where numbers total less than 8,000 individuals (Mello and Turner, in press. U.S. Fish Wildl. Serv. Endang. Species Rept. 6, Albuquerque, NM). Introduced into two other streams in NM (Behnke and Zarn 1976; Mello and Turner, in press). Other introductions planned (Gila Trout Recovery Plan 1979). Classified as endangered by USDI since 1967 (Fed. Reg. 40 [188]:44423).

ADULT SIZE: 110-150 mm SL, 260 mm SL maximum.



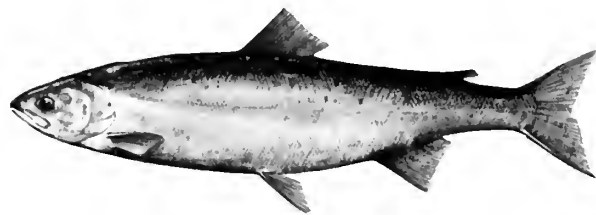
Hybridized/Undefined ▲
Literature records ○
Native ●
Introduced ○

BIOLOGY: Two studies conducted on Main Diamond Creek where apparently stunted population exists (Hanson 1971. M.S. thesis, New Mexico State Univ.; Regan 1966. U.S. Bur. Sport Fish. Wildl. Tech. Rept. 5: 1-24). Main Diamond Creek stock introduced into McKnight (Mello and Turner 1979) and Gap (orig. data) creeks reaches larger size. Spawning occurs April-May (8°C) and fry emerge in 45 to 60 days at 20-25 mm TL (Rinne, in press. Trans. Am. Fish. Soc.) Although limited in size by physical environment, high biomass per unit area relative to other salmonids is evidence of adaptability (Rinne 1978. in J. R. Moring (ed.) Proc. Wild. Trout-Catchable Trout Symp. Eugene, Ore., Ore. Dept. Fish Wildl. 113-25). Opportunistic feeder on Trichoptera, Ephemeroptera, Diptera, and Coleoptera (Regan 1966). Recorded in field at water temperature of 27°C (orig. data).

Compiler: J. N. Rinne. March 1979.

***Salmo salar* Linnaeus**
Atlantic salmon

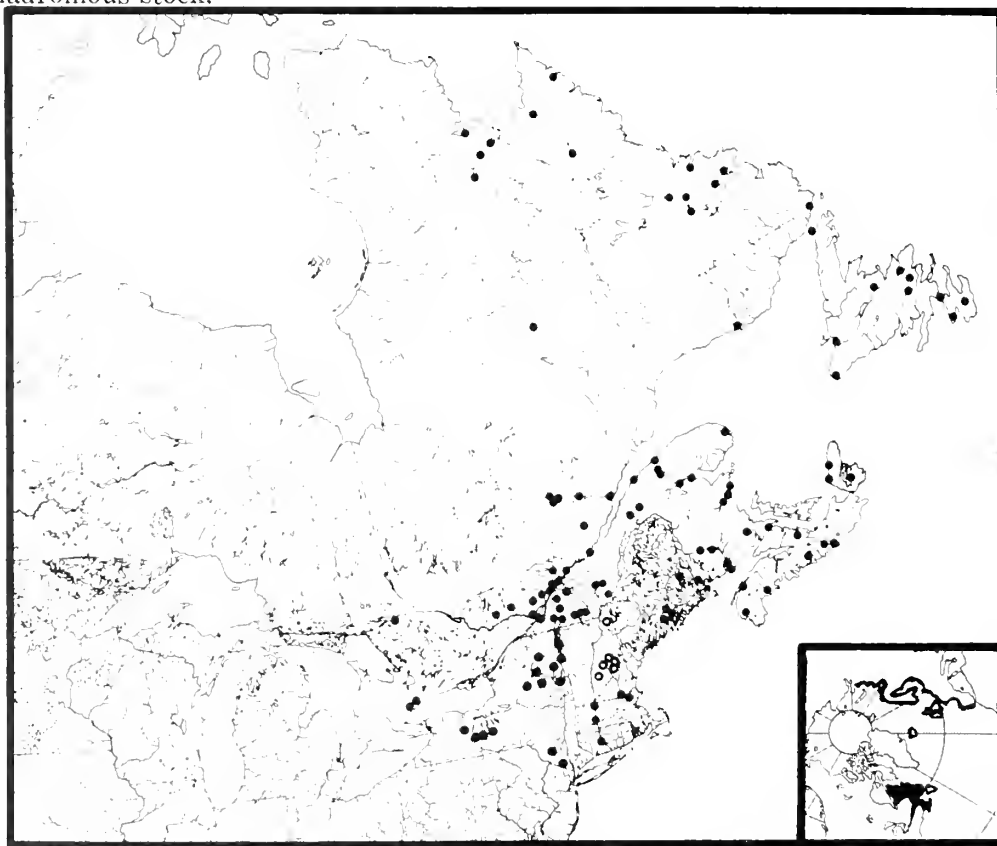
Order Salmoniformes
Family Salmonidae



(NMC)

TYPE LOCALITY: Seas of Europe (Linnaeus 1758, *Systema naturae*, Laurentii Salvii, Holmiae, 10th ed. 1:1-824).

SYSTEMATICS: Wilder (1974, Can. J. Res. Sect. D Zool. Sci. 25:175-89) and most subsequent workers concluded various populations do not warrant subspecific designation, although for years many freshwater populations regarded as taxonomically distinct from main anadromous stock.



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Native to North Atlantic Ocean from Portugal to Arctic Circle in east, and from northern QU south to Connecticut River in west. Some authors suggest originally ranged south to DE. Also known from Iceland and southern Greenland. A number of native landlocked populations known; species once found as far inland as Lake Ontario. Widely stocked in other freshwater lakes but seldom successfully. Spawning and nursery areas usually in gravelly streams, remainder of life spent at sea or in lakes. Native population south of ME apparently extirpated by dam construction. Starting to reappear in some of former range.

ADULT SIZE: 470-900 mm TL, landlocked populations with anadromous stocks generally larger (ca. 1400 mm maximum).

BIOLOGY: Freshwater and anadromous populations known. Havey and Warner (1970, Sport Fish. Inst. Wash. - Maine Dep. Fish. Game: 1-129) discussed life history and management of landlocked populations in ME. Scott and Crossman (1973, *Freshwater Fishes of Canada*) provided information on biology. Carlander (1969, *Handbook of Freshwater Fishery Biology* Vol. 1) reviewed extensive North American literature on both anadromous and freshwater populations. Unlike Pacific salmon which die after one spawning, individuals of this species often capable of spawning more than once.

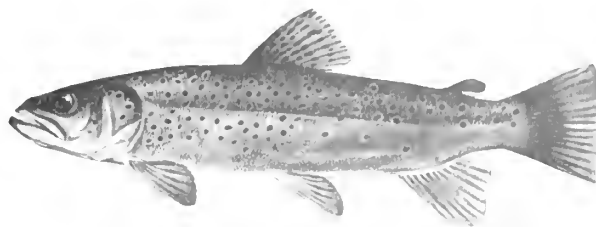
Compiler: D. S. Lee. February 1977.

***Salmo trutta* Linnaeus**
Brown trout

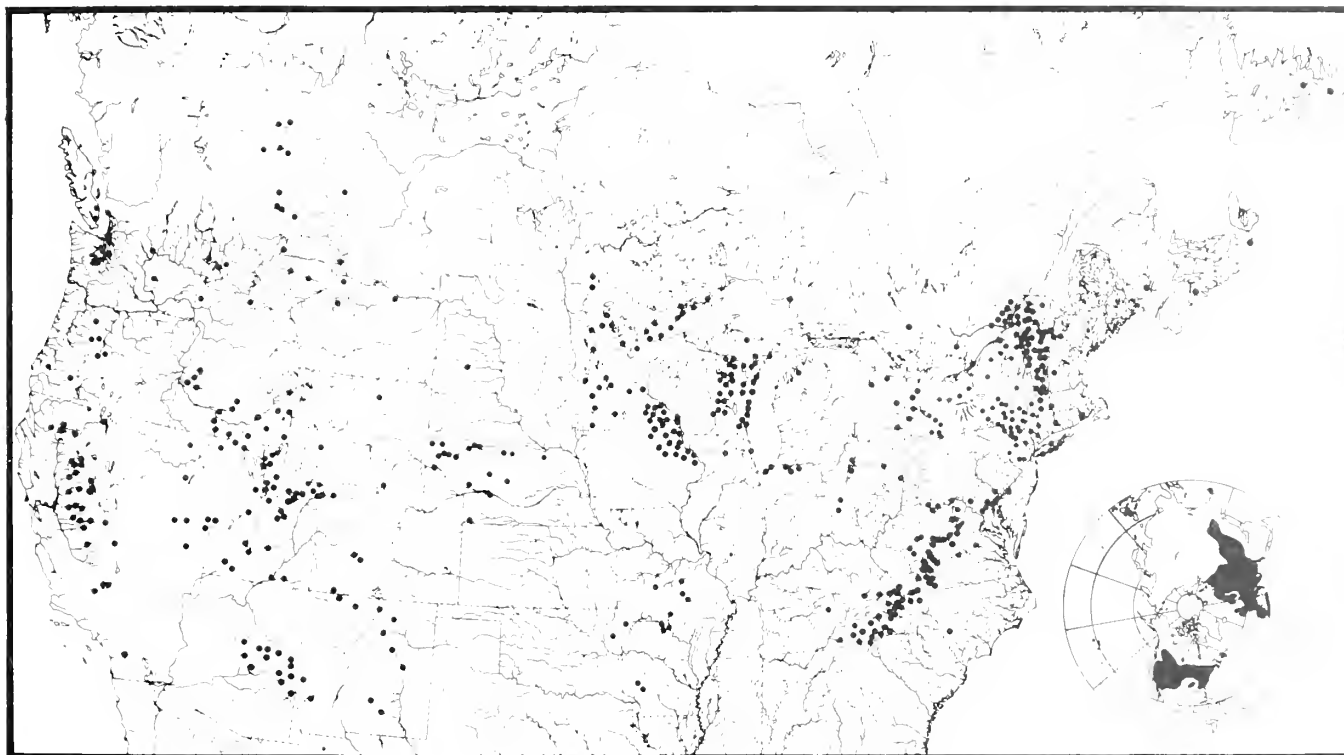
Order Salmoniformes
 Family Salmonidae

TYPE LOCALITY: "Europe" (Linnaeus 1758, *Systema naturae*, Laurentii Salvii, Holmiae, 10th ed., 1:1-824).

SYSTEMATICS: Subgenus *Salmo*. Rather variable within native range and number of subspecies recognized. Hybridizes with *Salvelinus fontinalis* in nature (hybrids called "tiger trout") and artificially hybridized with other salmonids (Scott and Crossman 1973, *Freshwater Fishes of Canada*; Buss and Wright 1958, *Trans. Am. Fish. Soc.* [1957] 87:172-81).



(N.C. Wildl. Resour. Comm.
 and NCSM)



DISTRIBUTION AND HABITAT: Native range in Europe and western Asia includes Ireland, British Isles, and mainland from Cape Kanin to Aral Sea and Afghanistan west through Europe. Stocking in North America started in 1883; now widely distributed throughout much of United States and Canada. MacCrimmon and Marshall (1968, *J. Fish. Res. Board Can.* 25:2527-48) and MacCrimmon et al. (1970, *J. Fish. Res. Board Can.* 27:811-18) reviewed transplants into North America and other parts of world. Mostly stocked in moderate to high gradient streams and rivers, although lake and sea-run populations established. Usually in habitats similar to those of brook or rainbow trout but tolerant of higher temperatures.

ADULT SIZE: 206-826 mm TL, 1029 mm TL maximum.

BIOLOGY: Widely studied. Comprehensive summary of world literature by Carlander (1969, *Handbook of Freshwater Fishery Biology* Vol. 1).

Compiler: D. S. Lee. February 1979.

Salvelinus agassizi (Garman)
Silver trout

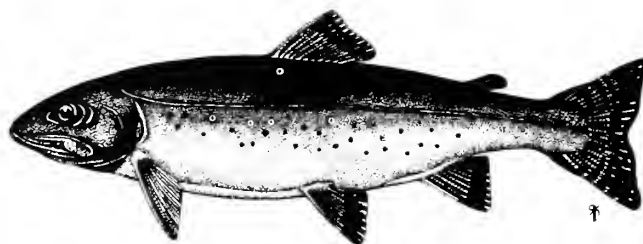
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Dublin Pond near Dublin, Cheshire Co., NH (Garman 1885. in 19th Annu. Rep. Comm. Inland Fish. [1884]:61-81).

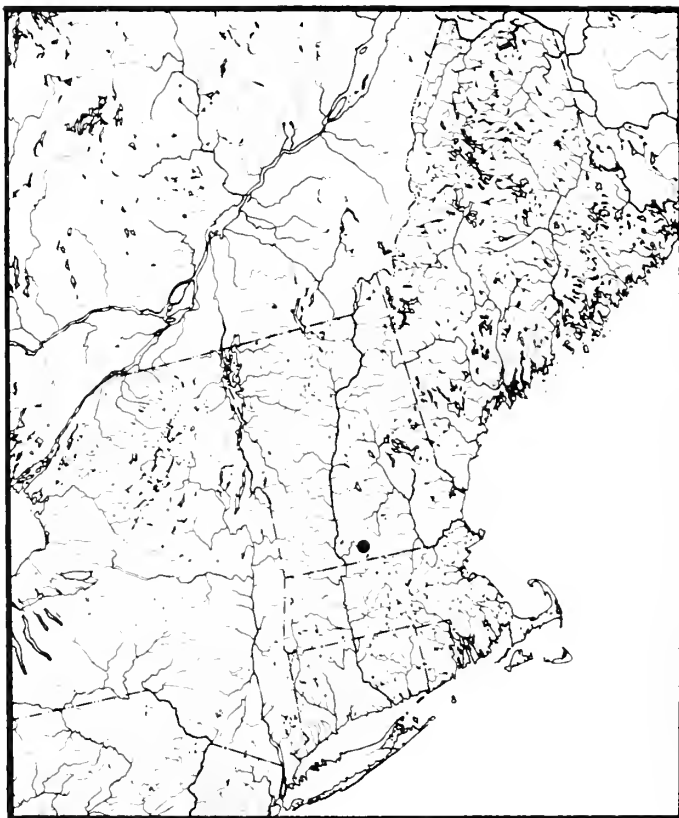
SYSTEMATICS: Historically thought to have closest affinity with *S. alpinus* (Arctic char) group by some workers; believed by others to be species most closely related to, or subspecies of, *S. fontinalis* (Kendall 1914. Mem. Boston Soc. Nat. Hist. 8:1-103). Regarded as species with nearest relative *S. fontinalis* by Behnke (1972. J. Fish. Res. Board. Can. 29:639-71) on basis of several characters, including morphology and coloration of 13 probable syntypes at USNM. Nineteen specimens, almost certainly syntypes, at MCZ, Harvard Univ. (K. E. Hartel, pers. comm.). Excellent color plate in Kendall (1914) undoubtedly served as template for color painting by Schwiebert (1978. *Trout*). Syntopic with *S. fontinalis*, also native to Dublin Pond.

DISTRIBUTION AND HABITAT: Known with certainty only from small, clear, cold, deep lake fed by bottom springs in Connecticut River drainage (Dublin Pond). Inhabited deep water during most of year, occupying upper levels over deep water and shallows only for brief period shortly after iceout and shallows during fall spawning. Apparently not rare in early 1800's. Decline possibly related to overfishing (including snatching, noosing, and netting in spawning area) and competition with yellow perch and brook trout, the latter introduced as well as native. Last known capture in 1930 (6 specimens, MCZ 40875), prior to analysis of Dublin Pond (Warfel 1939. Biological Survey of the Connecticut River Watershed. N.H. Fish Game Dept. Surv. Rep. 4:1-256).

ADULT SIZE: Specimens taken prior to 1850 usually 0.1-1.4 kg; 2.3 kg and one of 3.2 kg reported. Later declined in average size.



(NCSM)



BIOLOGY: From scant information, fed on aquatic insects, introduced shrimp, and "a dark greenish-brown vegetable material". Angled with artificial flies, worms, grasshoppers, minnows, and trout eggs. Reproduced in shallows for ca. 2-3 weeks during October, preparing redds in stony-sandy areas, and spawning at least partly during night. Reproduction of brook trout occurred in same areas, either concurrently or two weeks later. Data from Kendall (1914), who also reviewed history of species from scientific literature, popular accounts and conversation with residents of Dublin Pond area.

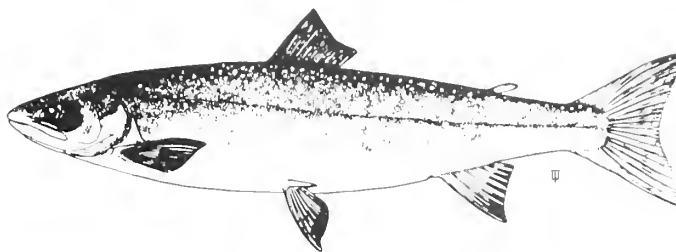
Compiler: R. E. Jenkins. February 1979.

Salvelinus alpinus (Linnaeus)
Arctic char

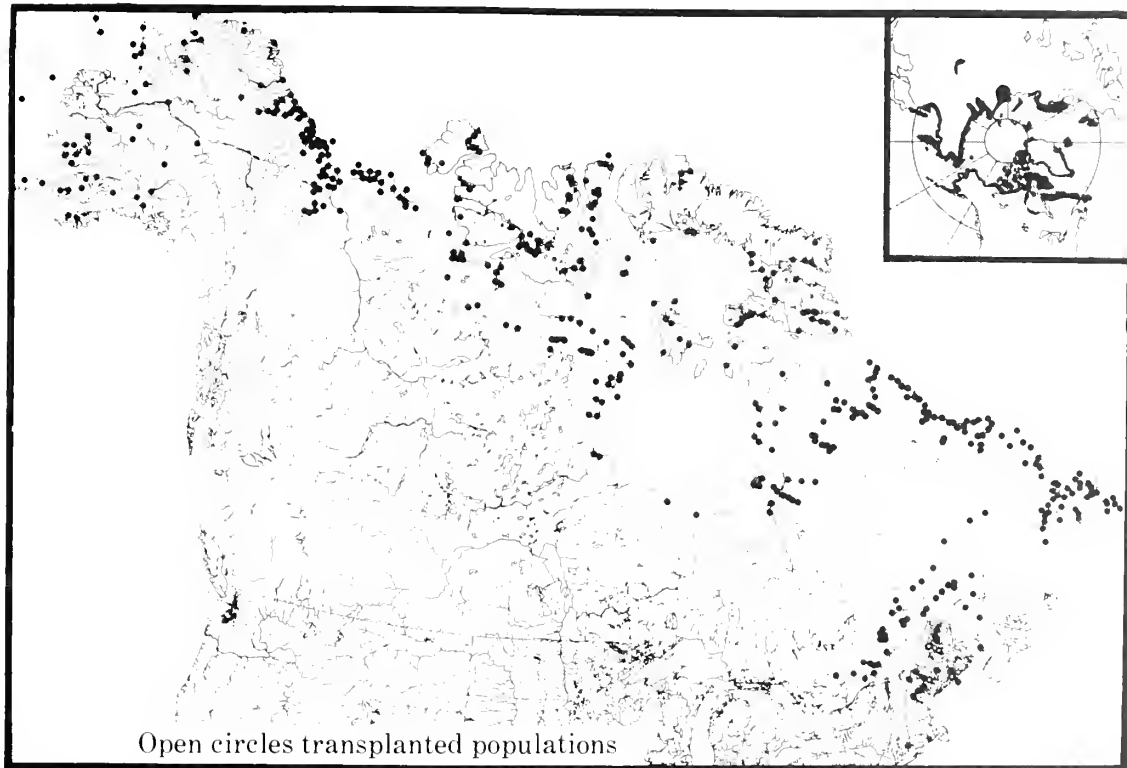
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Lapland, England, W. Gothland (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae 10th ed. 1:1-824).

SYSTEMATICS: Morrow (1973. Biol. Pap. Univ. Alaska 13:1-8) distinguished *S. anaktuvukensis* and Cavender (1978. Cal. Fish. Game 64:139-74) *S. confluentus* from *S. alpinus* and *S. malma*. McPhail (1961. J. Fish. Res. Board Can. 18:793-814) distinguished two forms of Arctic char on gill rakers and pyloric caeca. Qadri (1974. J. Fish. Res. Board Can. 31:1355-61) synonymized *S. aureolus* and *S. marstoni* with *S. alpinus oquassa*.



YU: Herschel Island, Beaufort Sea, ca. 370 mm SL (NMC).



DISTRIBUTION AND HABITAT: The Arctic char is circumpolar in distribution and the most northerly species of freshwater fishes. Anadromous or freshwater. Occurs in Iceland, Great Britain, Spitsbergen, Europe including the Alps and Scandinavia, northern Russia south to Lake Baikal and Kamchatka. In North America occurs from the Aleutian Islands in the west, north to northern Ellesmere Island, NT, and south to the Atlantic provinces, ME and NH, seldom more than 300 km from the sea. Absent from James Bay.

ADULT SIZE: Anadromous populations 450-635 mm FL, maximum 960 mm, freshwater populations highly variable but generally smaller.

BIOLOGY: Hunter (1970. Fish. Res. Board Can. Tech. Rep. 231:1-190) summarized biology. Marshall (1977. Env. Can. Fish. Mar. Serv. Tech. Rep. 621:1-49) provided a bibliography. Spawning occurs in autumn

usually over gravel in lakes or quiet pools of rivers at 4°C or less, in the south as late as December. Young feed on zooplankton and insect larvae, remaining in fresh water until about 200 mm in length, usually at 3-8 years of age. Anadromy occurs only during the summer with rapid egress following ice break-up and a return migration beginning about mid-August. Feeding in sea on crustacean zooplankton, but may include small fish such as capelin, sand lance, Arctic cod, and sculpin. Maturation of the marine form occurs at lengths greater than 450 mm and of land-locked forms between 150-200 mm. Spawning may be annual in the south, but in the north may be every two or more years. Growth rate is usually slower in the north with full size at 20 or more years, and for land-locked forms at 12 years.

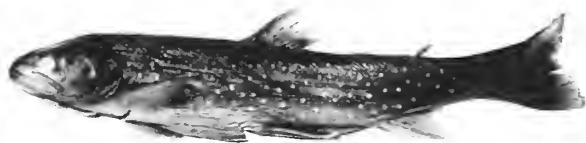
Compilers: J. G. Hunter, C. Renaud, and B. Parker. December 1978.

Salvelinus anaktuvukensis Morrow
Angayukaksurak char

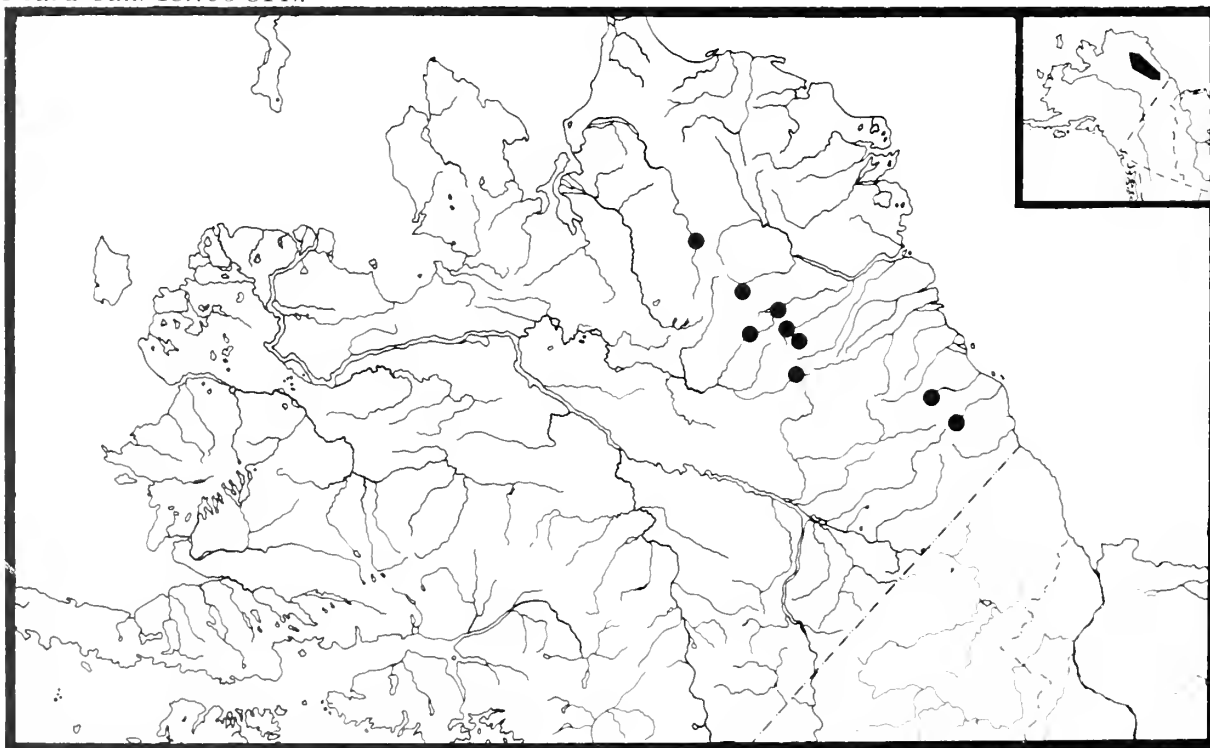
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Ikiakpuk (Ekokpuk) Creek, John River drainage, Brooks Range, AK (Morrow 1973. Biol. Pap. Univ. Alaska 13:1-8).

SYSTEMATICS: Dwarf form, adults black. First mentioned by Walters (1955. Bull. Am. Mus. Nat. Hist. 106:255-368), described by Morrow (1973), and statistically analyzed by Frohne (1973. Biol. Pap. Univ. Alaska 13:10-20). Apparently most closely related to *S. malma* (Frohne 1973). McCart and Craig (1973. J. Fish. Res. Board Can. 30: 1215-20) reported a spring-fed population on North slope, spawning in midwinter about three months later than anadromous populations. McCart (1974. Abstr. 54th. ASIH meetings) suggested there was no basis for designation of distinct species and that it was only an isolated spring population of the western Arctic Bering Sea form of Arctic char (McPhail 1961. J. Fish. Res. Board Can. 18:793-814).



AK: Ikiakpuk (Ekokpuk) Creek, 68° 01' 30" N, 152° 20' 56" W, male 247 mm SL (Morrow 1973).



DISTRIBUTION AND HABITAT: Somewhat discontinuous along crest of Brooks Range, AK, from Howard Pass east to Romanzoff Mountains. Reported from western part of Howard Pass; Killik River; Ikiakpuk (Ekokpuk), Giant, Contact, and Loon Lake creeks, all in John River drainage; Tolugak Lake, Kanayut (Shainin) Lake, Willow Creek in Anaktuvuk River drainage; Chandler; North Fork Koyukuk; Hula Hula and Aichilik rivers. In streams, confined to extreme headwater situations. In the few lakes where found, congregates on bottom in or near springs.

ADULT SIZE: 173-246 mm SL, 278.5 mm FL maximum.

BIOLOGY: Virtually unknown. Reported to overwinter in springs and to spawn in March-April. Extremely slow growing; specimens 230-275 mm FL are six to nine years old (Winslow 1969. Alaska Dept. Fish Game, Fed. Aid Fish Restor. Ann. Rept. Progress, Project F-9-1. 10:319-32).

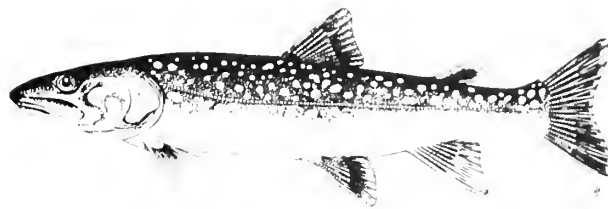
Compiler: J. E. Morrow. August 1979.

Salvelinus confluentus (Suckley)
Bull trout

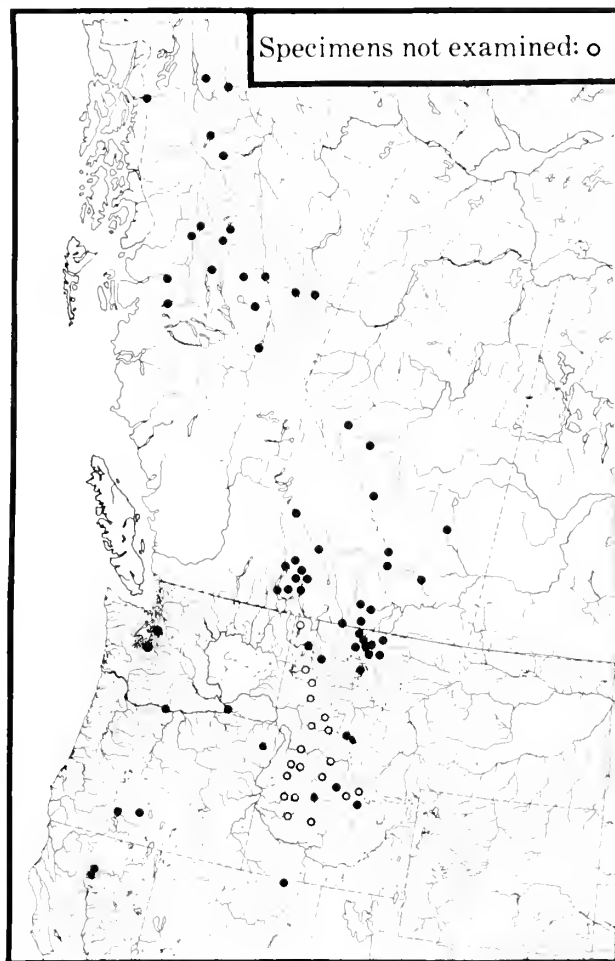
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Puyallup River near Fort Steilacoom, Pierce Co., WA (Suckley 1858. Ann. Lyceum Nat. Hist. 7:1-10).

SYSTEMATICS: Member of *S. alpinus* complex. Long confused with *S. malma*, especially where ranges overlap on Pacific slope; this differs from conclusions of McPhail (1961. J. Fish. Res. Board Can. 18:793-814), who regarded the bull trout as conspecific with *S. malma*. Specific distinction given by Cavender (1978. Calif. Fish Game 64: 139-74). Closest relative may be *S. kronocius* from Lake Kronotskoye, Kamchatka, USSR.



(NCSM)



DISTRIBUTION AND HABITAT: North-south distribution in coastal and montane areas of Pacific Northwest between 48° and 60°N latitude. North of 49th Parallel. In most major drainages on both sides of Continental Divide. Rare and localized at southern periphery of range. In large, cold rivers and lakes draining high mountainous areas, especially where snowfields and glaciers present. Frequents bottoms of deep pools.

ADULT SIZE: 350-900 mm SL.

BIOLOGY: Most information combined with account of *S. malma*. Summary by Scott and Crossman (1973. *Freshwater Fishes of Canada*). Principal food is fish but will prey on other vertebrates of suitable size (Brown 1971. *Fishes of Montana*). Migratory during late summer and fall spawning season. Young found in tributary streams (Moyle 1976. *Inland Fishes of California*).

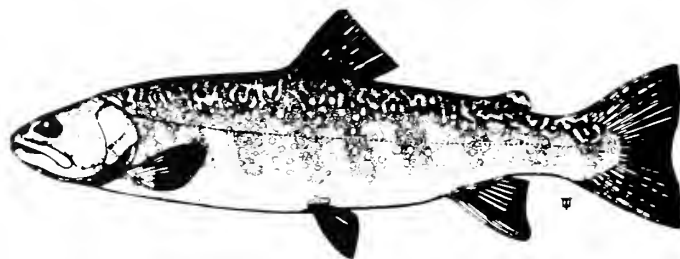
Compiler: T. M. Cavender. June 1979.

Salvelinus fontinalis (Mitchill)
Brook trout

Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Vicinity of New York City, NY (Mitchill 1814. Rept. on Fishes of New York:1-30).

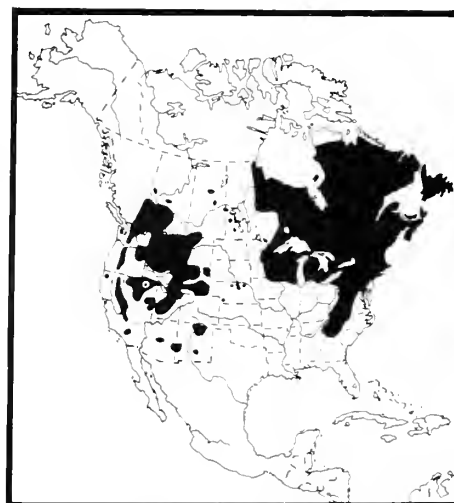
SYSTEMATICS: Subgenus *Baione*. *Salvelinus timagamiensis* (Henn and Rinkenback 1925. Ann. Carnegie Mus. 16:131-4), now extinct, is considered to have been a subspecies (Sale 1967. Can. J. Zool. 45:215-25; Qadri 1968. Natl. Mus. Can. Bull. 237:1-18; Behnke 1972. J. Fish. Res. Board Can. 29: 639-71). Southern Appalachian populations not regarded as taxonomically distinct, on basis of comprehensive studies now in manuscript (R. D. Estes, pers. comm.). Extinct *S. agassizi* elevated to species status by Behnke (1972). Anadromous and freshwater populations taxonomically indistinct (Wilder 1952. J. Fish. Res. Board Can. 9:169-203). Opinions regarding relationships between *S. fontinalis* and other salmonids not unanimous (Rounsefell 1962. U.S. Fish Wildl. Serv. Fish. Bull. 62:235-70; Behnke 1972).



ON: Algonquin Park, ca. 25 mm SL (NMC).



Former Distribution



Present Distribution

Maps modified from MacCrimmon and Campbell 1969

DISTRIBUTION AND HABITAT: In clear, cold streams and lakes. Native to eastern North America. Throughout much of eastern Canada from Hudson Bay drainages south through New England states, the Great Lake drainages and upper Mississippi basin west to MN. South in Appalachian Mountains to GA. Introduced to higher elevations in western North America and temperate regions of other continents. MacCrimmon and Campbell (1969. J. Fish Res. Board Can. 28:452-56) studied movements between and within fresh and salt water.

ADULT SIZE: 200-400 mm SL.

BIOLOGY: Numerous papers consider biology and management of this species. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) provided excellent summary as did Bridges and Mullen (1958. Mass. Division of Fisheries and Game, Fisheries Bull. 28:1-38). Scott and Saunders (1958. J. Fish. Res. Board Can. 15:1403-49) studied movements between and within fresh and salt water.

Compiler: M. L. Hendricks. October 1978.

Salvelinus malma (Walbaum)
Dolly Varden

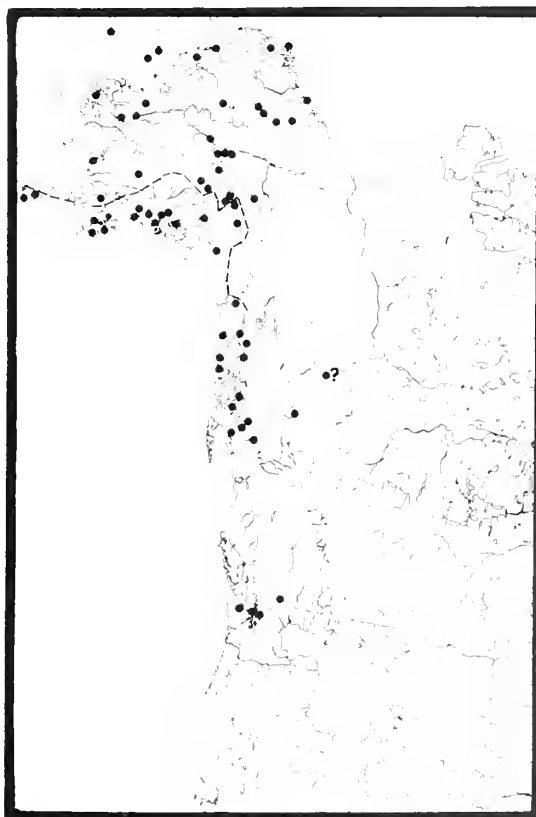
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Streams of Kamchatka Peninsula, Siberia, USSR (Walbaum in Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Member of *S. alpinus* complex; systematics of North American forms reviewed by McPhail (1961. J. Fish. Res. Board Can. 18:793-814). Related to Pacific group of chars including *S. leucomaenis*, *S. pluvius*, and *S. confluentus*. Two recognizable forms (separated by dashed line on map) on eastern side of Pacific (Morrow in press in Balon. *Charrs: Salmonid Fishes of the Genus Salvelinus*); northern form occurs throughout AK north of Alaska Range, and southern form present south of Alaska Range, extending west along Aleutians and south to Pacific coastal regions of United States. On western side of Pacific at least three subspecies recognized (*S. m. malma*, *S. m. schmidtii*, and *S. m. krascheninnicovi*) by Viktorovsky (1978. *Mechanisms of Speciation in Chars of Lake Kronotsk*).



AK: 21 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Range spans entire arc of North Pacific, from Sea of Japan and Kuril Islands, across Aleutian chain to AK, north in Chukchi and Beaufort seas and south along North American Pacific coast to northwestern United States. Typically anadromous but many populations landlocked. A number of dwarfed races known.

ADULT SIZE: 250-500 mm SL (anadromous populations)

BIOLOGY: Most information on AK populations summarized by Armstrong and Morton (1969. Alaska Dep. Fish. Res. Rep. 7). Excellent summary in Scott and Crossman (1973. *Freshwater Fishes of Canada*).

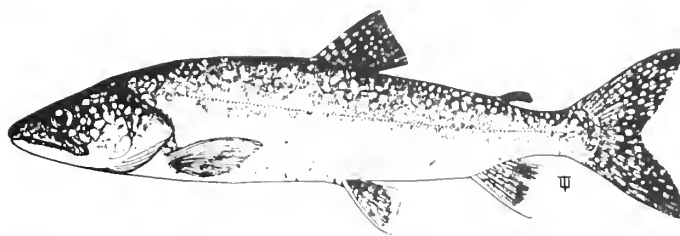
Compiler: T. M. Cavender, June 1979.

***Salvelinus namaycush* (Walbaum)**
Lake trout

Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Hudson Bay (Walbaum in Artdi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: *Salvelinus n. siscowet* from the deeper waters of Lake Superior and *S. n. huronicus* from Rush Lake, MI, recognized by some authors; elsewhere and in shallower waters of Lake Superior is found nominate subspecies, *S. n. namaycush*. Eschmeyer and Phillips (1965. Trans. Am. Fish. Soc. 94:62-74) established genetic differences in fat content of two Lake Superior subspecies. Khan and Qadri (1970. J. Fish. Res. Board Can. 27:161-67; 1971. J. Fish. Res. Board Can. 28:465-76) discussed taxonomy and distribution of species. Placed in distinct genus, *Cristivomer*, by Qadri (1967. J. Fish. Res. Board Can. 24:1407-11) and Vladykov (1964. Trans. Roy. Soc. Can. 1: 459-504).



NT: Broughton Island, 360 mm SL (NMC).



See map on next page

DISTRIBUTION AND HABITAT: Native and widely distributed in North America, introduced elsewhere. Great Lakes region north to tip of QU, east to NS, west to southern AT, interior of BC, YT, and AK, (missing in southern prairie provinces), and north to King William, Victoria and Banks islands. Marshall and Keleher 1970 (Fish. Res. Board Can. Tech. Rep. 176:1-60) gave bibliography and listed introductions. Occur only in deep lakes in southern portion of range and shallow and deep waters of northern lakes. Least tolerant of salt water of all chars. Lindsey (1964. J. Fish. Res. Board Can. 21:977-94) said it is only freshwater species ranging into far north of Canada and AK that does not extend west into Siberia. He suggested absence due to presence of large predatory lampreys. May have survived glaciation in refugia on Atlantic coast, in upper Mississippi and Missouri, and in AK-YT, but not south of ice sheet in Pacific drainages (Khan and Qadri 1971). Confirmation needed for Baffin Island, NT, records.

ADULT SIZE: 381-508 mm TL, maximum 1260 mm TL.

BIOLOGY: Nocturnal spawning from September in north to June in south, over boulder or rubble bottom in inland lakes, at depths from 5-37 m and sometimes as shallow as 0.3 m. Water temperatures varied from 8.9 C to 13.9 C in south. Hatching occurs March to June. Sexual maturity attained in 6-13 years. Feeds on broad range of organisms from plankton and insects to fishes and mice, but sculpins and cisco appear preferred. Burbot, bullhead, and round whitefish feed on lake trout eggs, and sea lampreys parasitize adults in Great Lakes.

Compilers: B. Martin, S. P. Platania, and D. E. McAllister. December 1978.

Distribution of lake trout, *Salvelinus namaycush*



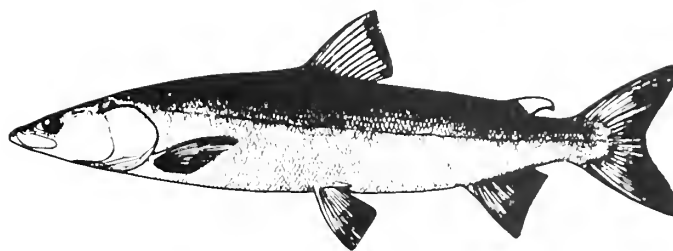
Open circles transplanted populations

Stenodus leucichthys (Güldenstadt)
Inconnu

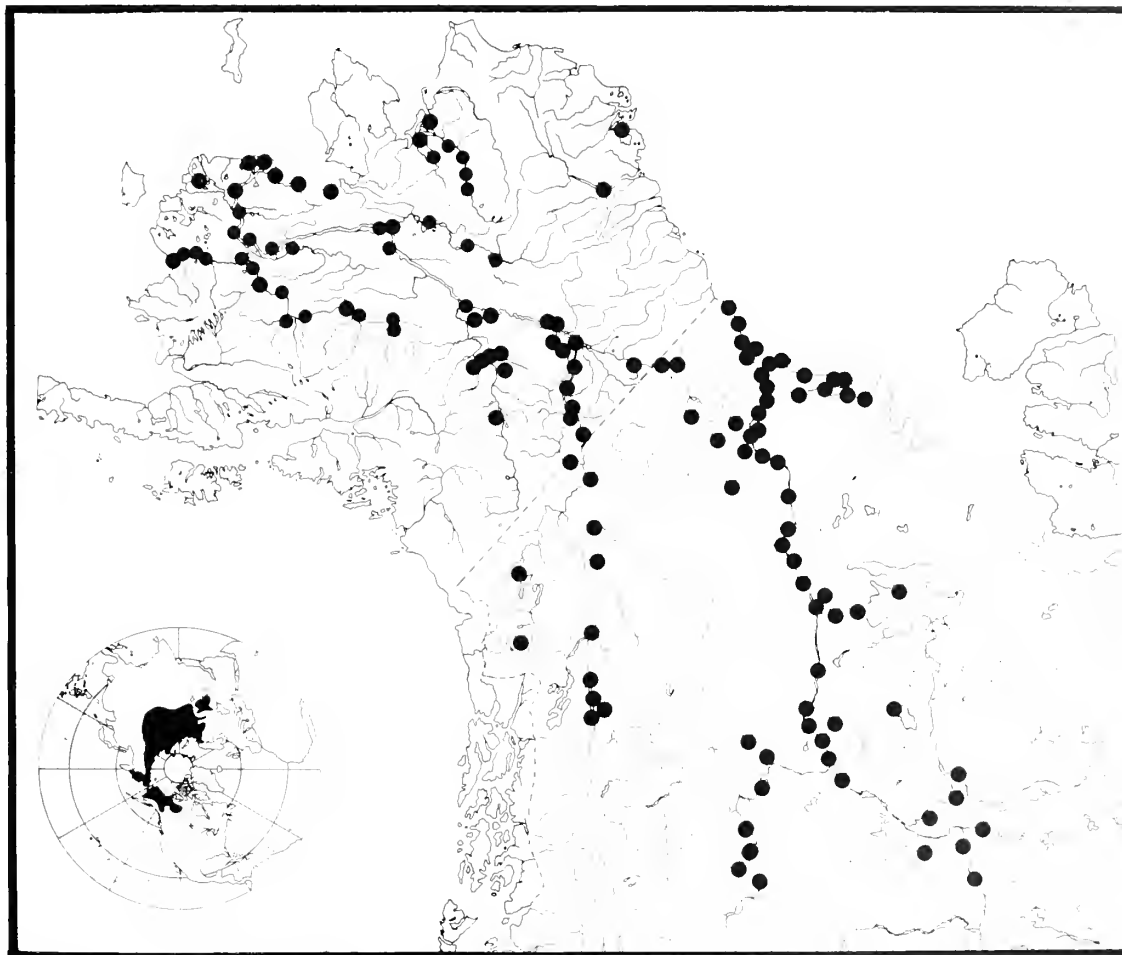
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Caspian Sea drainages (Güldenstadt 1772. Novi. Comment. Acad. Petropol. 16 [1771]:531-47.)

SYSTEMATICS: Two subspecies; *S. l. nelma*, the North American and Siberian form, and *S. l. leucichthys*, which is restricted to the Caspian Sea drainage (Shaposhnikova 1967. Vopr. Ikhtirol. 7:227-39). Alt (1969. Biol. Pap. Univ. Alaska 12:1-61) reported on taxonomy.



433 mm SL (NMC).



DISTRIBUTION AND HABITAT: Arctic drainage of northwestern North America and Asia west to White Sea. An isolated population occurs in the Caspian Sea. Northern American range is from Kuskokwim River, Bering Sea, AK, to Anderson River near Cape Bathurst, NT. In coastal areas the species is anadromous, but in inland lakes it remains in fresh water.

ADULT SIZE: 457-762 mm TL, 999 mm TL maximum.

BIOLOGY: Individuals spawn during late summer or early autumn once every two, three, or four years. They reach sexual maturity in seven to ten years and seldom live

more than 11 years (Fuller 1955. J. Fish. Res. Board Can. 12:768-80), with 20 years as the maximum (Alt 1969; 1973. J. Fish. Res. Board Can. 30:457-59; Berg 1948. *Freshwater Fishes of the U.S.S.R. and Adjacent Countries* Vol. 1). Food of adults in Great Slave Lakes consists almost entirely of small fishes (Dymond 1943. Trans. Roy. Can. Inst. 24:171-232). Fuller (1955) discussed parasites. Berg (1948) gave a detailed account of biology and life history of Asian populations.

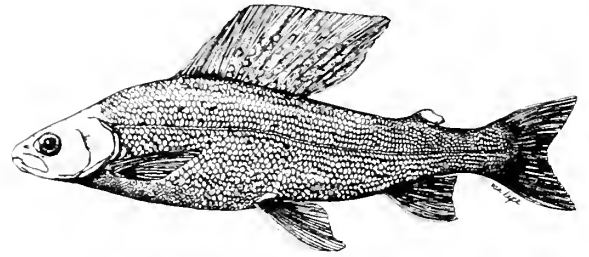
Compilers: D. E. McAllister and S. P. Platania. March 1978.

Thymallus arcticus (Pallas)
Arctic grayling

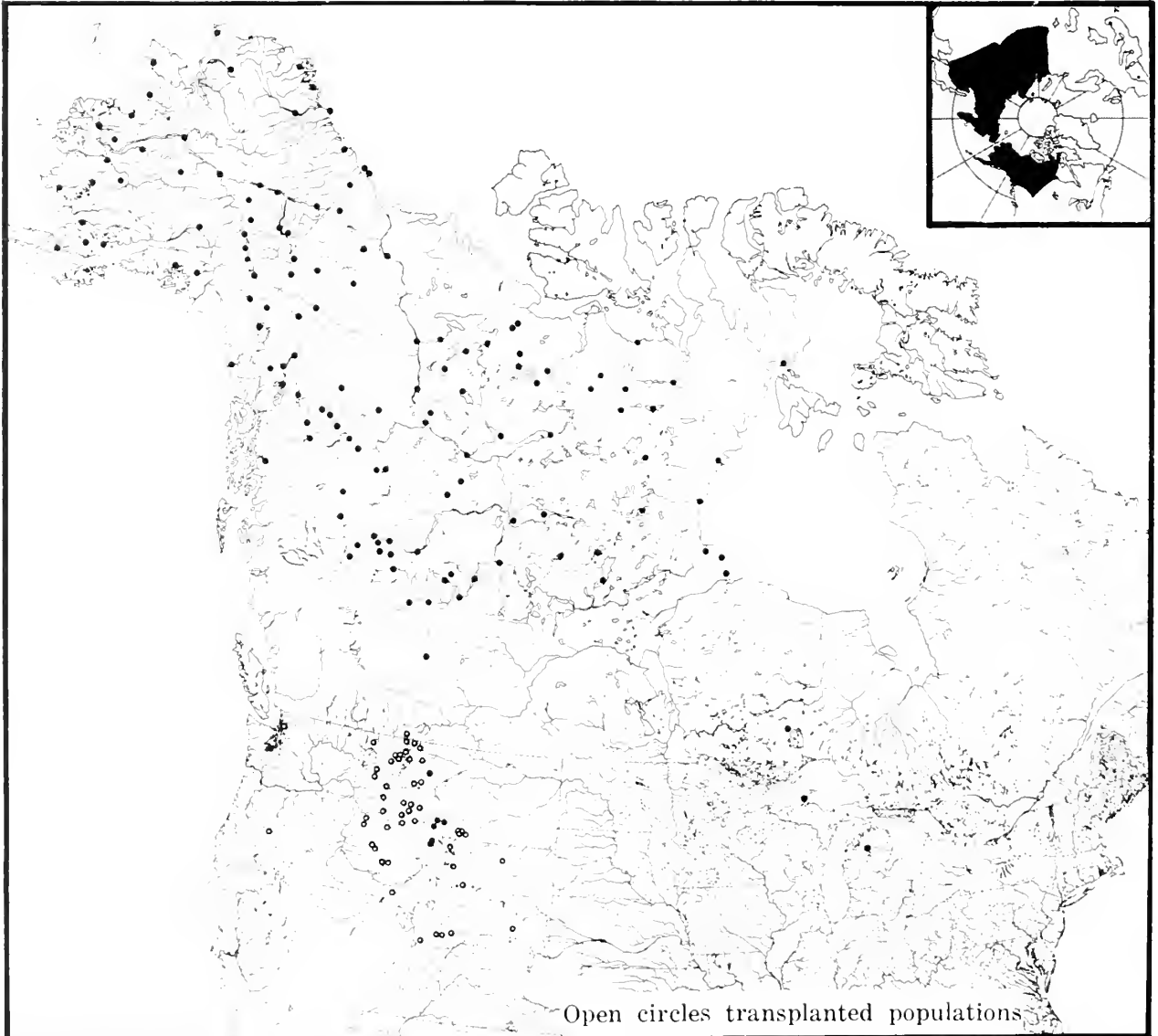
Order Salmoniformes
Family Salmonidae

TYPE LOCALITY: Ob River, Siberia (Pallas 1776. *Reise durch verschiedene Provinzen des Russischen Reichs* [1768-74] Vol. 3).

SYSTEMATICS: Once were four isolated stocks in North America which were considered separate species: *T. signifer*, *T. montanus*, *T. tricolor*, and *T. ontariensis*. Walters (1955. Bull. Am. Mus. Nat. Hist. 106:259-368) considered *T. signifer* synonymous with *T. arcticus*, and the others as subspecies.



AK: 25 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Hudson Bay west to AK, headwaters of Missouri River, MT. Once in rivers flowing into lakes Michigan, Huron, and Superior in northern MI. Extirpation from MI documented by Taylor (1954. Misc. Publ. Mus. Zool. Univ. Mich. 87:1-50). Introduced elsewhere as far south as

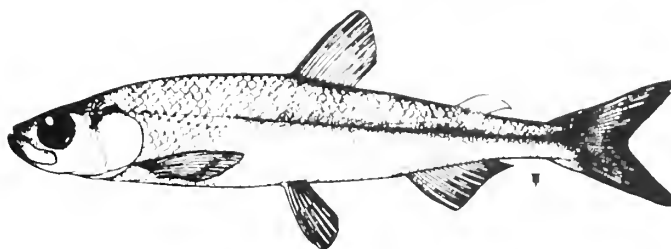
CA, AZ, and NV. Clear waters of large cold rivers, rocky creeks, and lakes.

ADULT SIZE: 305-381 mm TL.

BIOLOGY: Scott and Crossman (1973) summarized data on spawning, fecundity, age and growth, food habits, and parasites. Compiler: F. C. Rohde. April 1978.

***Hypomesus olidus* (Pallas)**
Pond smelt

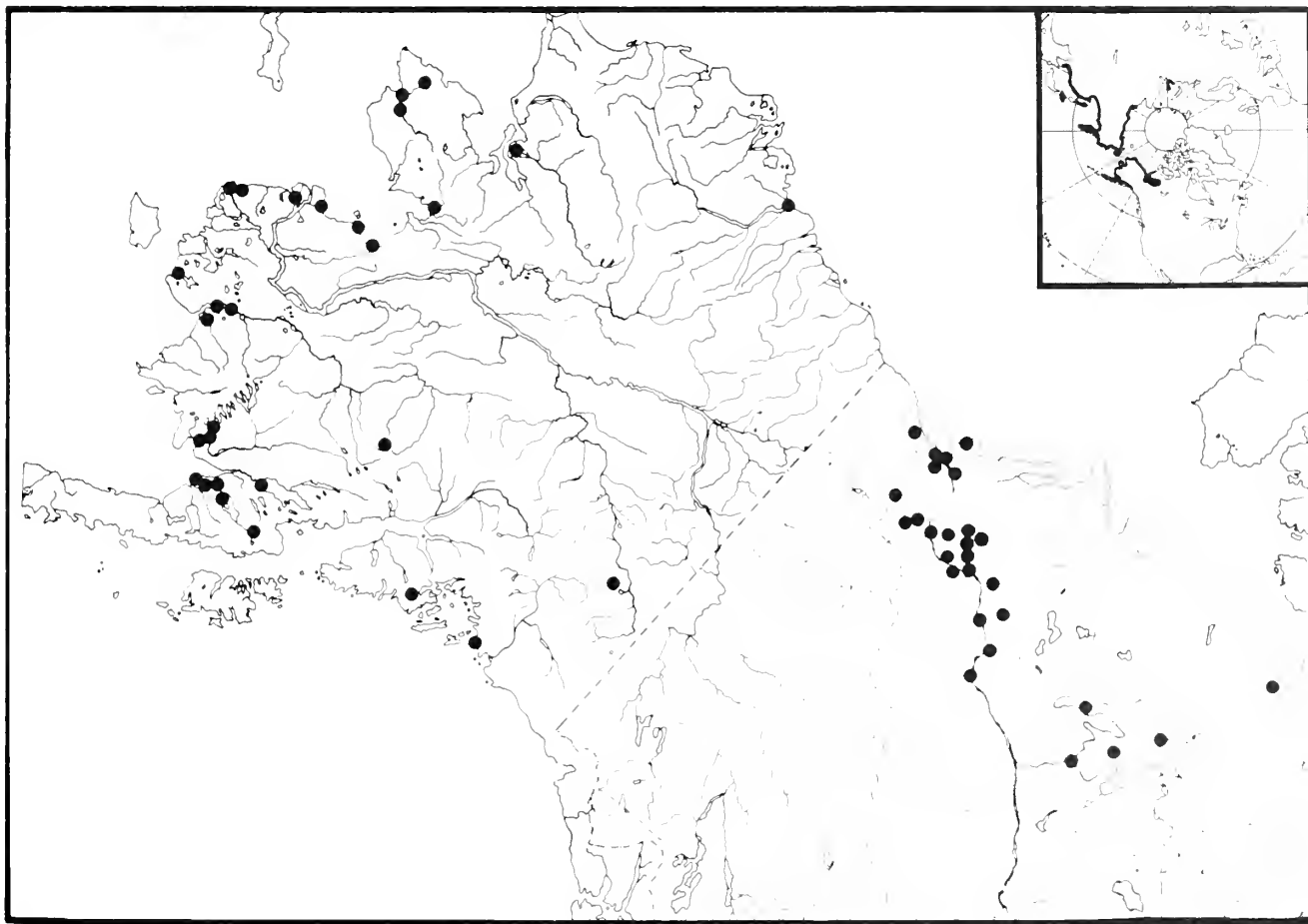
Order Salmoniformes
Family Osmeridae



AK: Bristol Bay, 90 mm SL
(NMC).

TYPE LOCALITY: Rivers and lakes of Kamchatka, Kamchatka River (Pallas 1814, Zoogeographica Rosso-Asiatic 3:1-423; date from Opinion 212, Int. Comm. Zool. Nomencl.).

SYSTEMATICS: Hamada (1957, Jpn. J. Ichthyol. 5:136-42) first distinguished *H. transpacificus* (named by McAllister 1963, Natl. Mus. Can. Bull. 191:1-53) from *H. olidus*. California records and most Honshu, Japan, records under this name are actually *H. transpacificus*. *Hypomesus sakhalinus* is synonym of *H. olidus*. Subspecies not currently recognized.



DISTRIBUTION AND HABITAT: Wansan, Korea, in Pacific, north to Alazeya River, Siberia, including Hokkaido and Sakhalin, with isolated population in Lake Krugloe, Yamale, USSR, in Kara River drainage. In North America from Copper River north to Kobuk River, AK, east to lower Mackenzie River system including Great Bear Lake, NT, and Rae River, Coronation Gulf.

ADULT SIZE: 75-150 TL, 200 mm TL maximum.

BIOLOGY: De Graaf (1974, Canada Arctic Gas Study, Biol. Rep. Ser. 18:1-89) reported on life history. Spawns in June in AK and YT in shallow water over organic debris. Adhesive eggs hatch in 18 days at 10°C. Few live more than five years. Feeds primarily on zooplankton, some on surface insects.

Compilers: D. E. McAllister, R. Boyle, and B. Parker. July 1979.

Hypomesus pretiosus (Girard)
Surf smelt

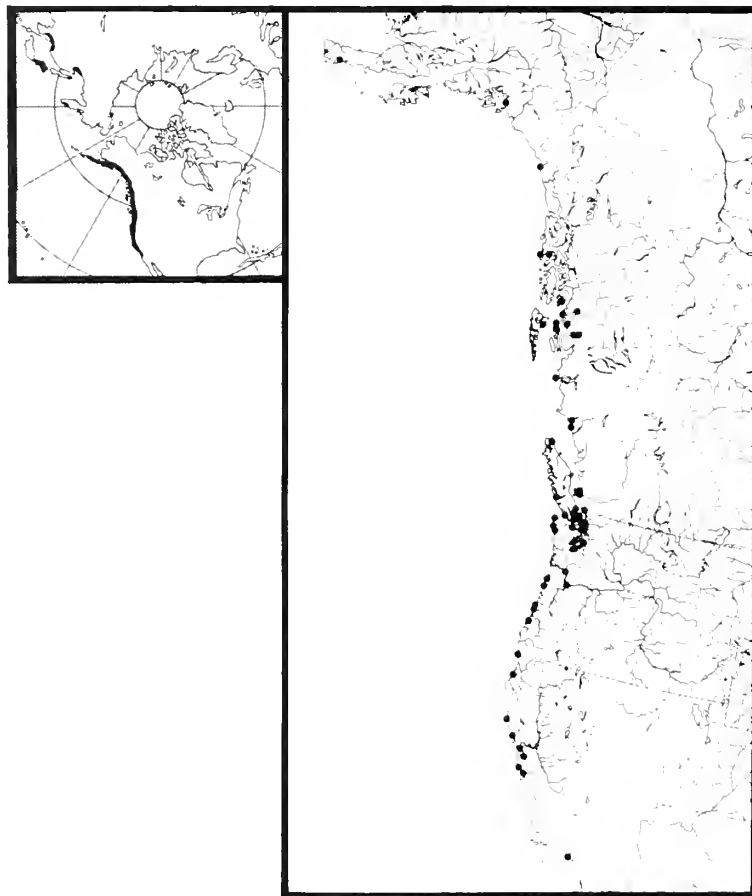
Order Salmoniformes
Family Osmeridae

TYPE LOCALITY: Presidio (San Francisco), CA (Girard 1854. Proc. Acad. Nat. Sci. Phila. [1854-55] 7:142-56.

SYSTEMATICS: McAllister (1963. Bull. Natl. Mus. Can. 191:1-53) discussed taxonomy and recognized two subspecies, *H. p. pretiosus* of North America and *H. p. japonicus* of Coastal Asia. Klyukanov (1975. Zool. Zh. 54:590-96; 1977. Acad. Sci. USSR., Zool. Inst.: 13-27) raised these to species status.



AK: Yakutat Bay, ca. 17 cm
SL (Jordan and Evermann
1900).



DISTRIBUTION AND HABITAT: North American form ranges from Long Beach, CA (rare south of San Francisco), north to Olsen Bay, Prince William Sound, AK, and west to Izembek Bay, Alaska Peninsula, AK; Asian form ranges from Wonsan, Korea, to Petropavlovsk, Kamchatka, and Udskeya Gulf, sea of Okhotsk, USSR. Marine, sometimes in brackish water, rarely in fresh water (Sandy River, OR); in midwaters in deep scattering layer.

ADULT SIZE: 100-200 mm TL, 305 mm TL maximum.

BIOLOGY: Hart and McHugh (1944. Bull. Fish. Res. Board Can. 64:1-27) and Hart (1973. Bull. Fish. Res. Board Can. 180:1-740) summarized life history and Gruchy and McAllister (1972. Fish. Res. Board Can. Tech. Rep. 368:1-104) published bibliography for family. Spawns during most months at high tide on sand and gravel beaches, laying 1,320-29,950 adhesive eggs that hatch in as little as 10 to 11 days (longer in fall and winter). Lives at least three years. Feeds on crustaceans, copepods, amphipods, crabs, larvae, euphausiids, etc., and fed upon by chinook salmon.

Compiler: D. E. McAllister. November 1978.

Hypomesus transpacificus McAllister
Delta smelt

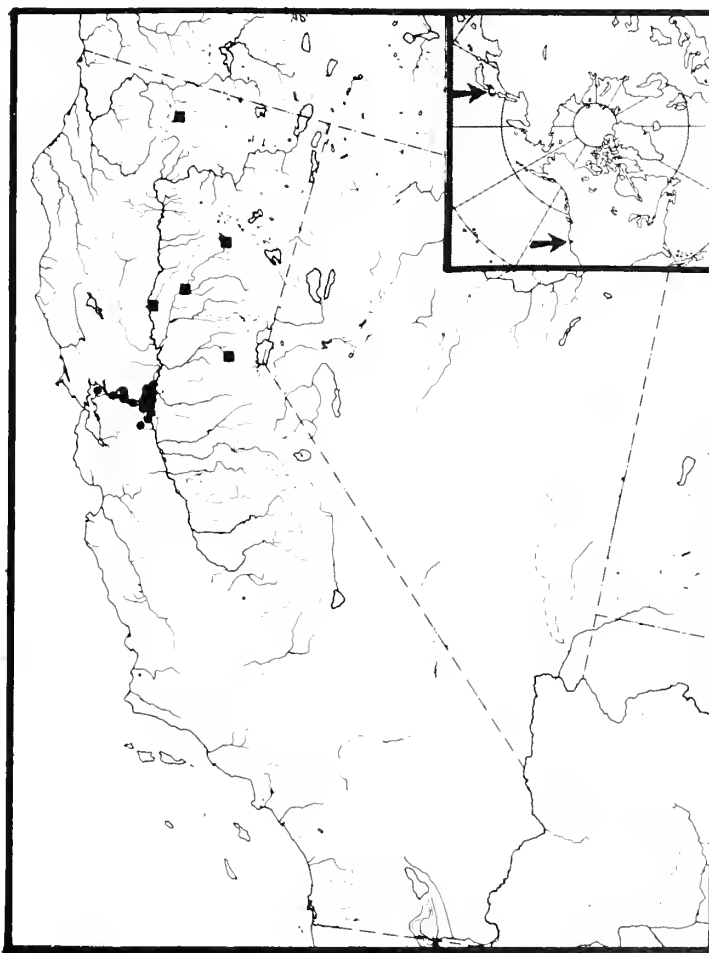
Order Salmoniformes
Family Osmeridae

TYPE LOCALITY: Lower San Joaquin River between Three Mile Slough and False River, CA (McAllister 1963. Natl. Mus. Can. Bull. 191:1-53).

SYSTEMATICS: Closely related to *H. olidus*. McAllister (1963) divided *H. transpacificus* into *H. t. transpacificus* of CA and *H. t. nipponensis* of Japan. Klyukanov (1975. Zool. Zh. 54:590-96) considered the two to be distinct species.



CA: Sacramento-San Joaquin
Delta, 83 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: *Hypomesus t. transpacificus* is confined to Sacramento-San Joaquin Delta region, in larger channels where water is fresh to brackish (circles on map). *Hypomesus t. nipponensis* has been successfully introduced into a number of CA reservoirs(squares on map).

BIOLOGY: Apparently lives only one year and dies after spawning. Midwater feeder on copepods and opossum shrimp, *Neomysis*. Life history summarized in Moyle (1976. *Inland Fishes of California*).

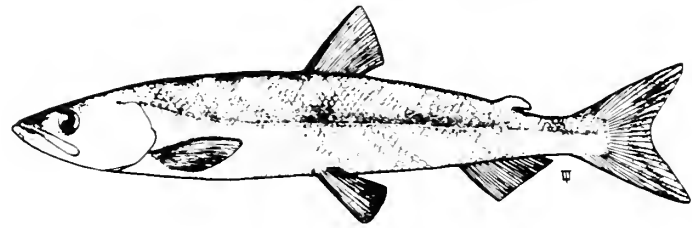
ADULT SIZE: 55-70 mm SL, 120 mm SL maximum.

Compiler: P. B. Moyle. July 1978.

Osmerus mordax (Mitchill)
Rainbow smelt

Order Salmoniformes
Family Osmeridae

TYPE LOCALITY: New York (Mitchill 1814. Rept. on Fishes of New York: 1-30).
SYSTEMATICS: McAllister (1963. Natl. Mus. Can. Bull. 191:1-53) recommended treatment of non-European smelt as subspecies of European smelt unless the two forms could be found in sympatry without crossing. Kluikanov (1969. Zool. Zh. 48:99-109) found them sympatric in White Sea; hence European smelt can be recognized



YU: Herschel Island, Beaufort Sea, 231 mm SL (NMC).



as species, *O. eperlanus*, distinct from *O. mordax*. Kluikanov (1969) distinguished eastern North American *O. m. mordax* from North Pacific-Arctic *O. m. dentex*, although there is now some evidence against this separation. Delisle (1969. Ph.D. disser. Univ. Ottawa) and Copeman (1977. J. Fish. Res. Board Can. 34:1220-29) showed that a dwarf and a larger form coexist in some lakes in eastern North America. They differ morphologically and biologically, and are probably good species.

DISTRIBUTION AND HABITAT: Barkley Sound, Vancouver Island, BC and Wonsan, Korea in the Pacific north and west to White Sea and north and east to Bathurst Inlet and in Arctic Ocean; in eastern North America, from Delaware River, PA (and questionably from VA), north to Pike Run, Lake Melville, Labrador. Introduced into

many lakes in eastern North America, including Great Lakes. Halkett (1913. *Checklist of the Fishes of the Dominion of Canada and Newfoundland*) reported from Nass River, BC, but there are no voucher specimens. Common in lakes, streams, rivers and coastal waters. Some populations anadromous, others strictly freshwater.

ADULT SIZE: 100-250 mm TL (normal), 75-100 (dwarf).

BIOLOGY: Prefers cool clear water. Spawns on gravel in streams or lakes in spring, eggs adhere to bottom. Feeds on crustaceans, insect larvae, worms, and fish. Preyed on by trout, burbot, walleye, perch, and birds. Important sport, commercial, and forage fish.

Compilers: D. E. McAllister, B. Parker and K. E. Couvillion. Sept. 1978.

Spirinchus thaleichthys (Ayres)
Longfin smelt

Order Salmoniformes
Family Osmeridae

TYPE LOCALITY: San Francisco, CA (Ayres 1860. Proc. Calif. Acad. Sci. [1858-1862] 2:52-64).

SYSTEMATICS: McAllister (1963. Natl. Mus. Can. Bull. 191:1-53) and Kluikanov (1971. Zool. Zh. 50:84-88) discussed taxonomy. McAllister (1963) synonymized *S. dilatus* with *S. thaleichthys*.



CA: Sacramento-San Joaquin Delta, 94 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Sacramento-San Joaquin estuary, CA, north to Hinchinbrook Island, Prince William Sound, AK. In coastal waters and rivers, but landlocked in Harrison Lake, BC, and lakes Washington and Union, WA. Taken to 150 m depth in the sea.

ADULT SIZE: 90-120 mm SL in anadromous form, but landlocked form may be smaller; maximum 135 mm SL.

BIOLOGY: Anadromous or landlocked. Spawns in streams from October to November in BC, December to February in CA, in second year; some may survive spawning. Females lay 5,000-24,000 adhesive eggs which hatch in about 40 days. Young descend streams to lake or sea. Food consists of small crustacea and fish. Hart and McHugh (1944. Bull. Fish. Res. Board Can. 64: 1-27) provided life history information.

Compiler: D. E. McAllister, September 1978.

Thaleichthys pacificus (Richardson)
Eulachon

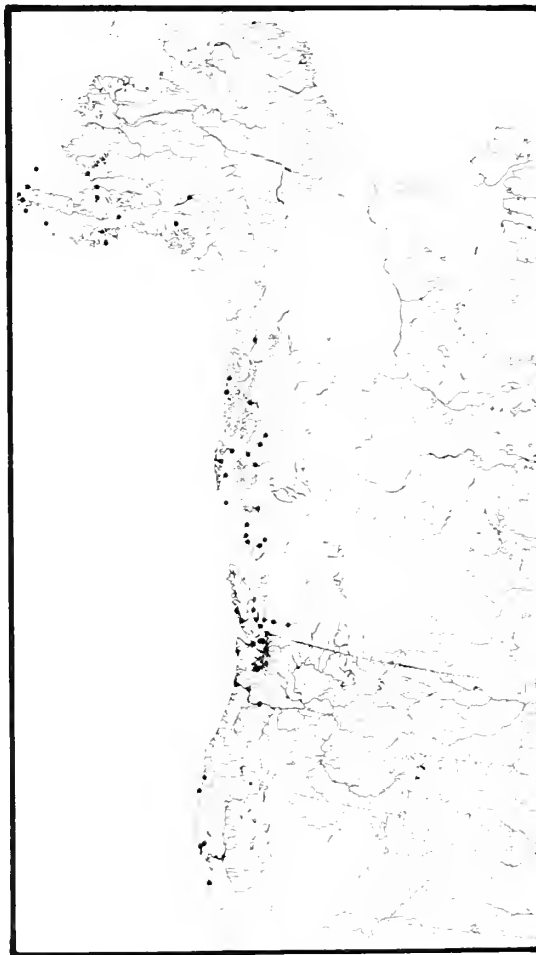
Order Salmoniformes
Family Osmeridae

TYPE LOCALITY: Lower Columbia River no higher than the Katpootl, a tributary that joins it about 100 km from its mouth, WA (Richardson 1836. *Fauna Boreali-Americana*).

SYSTEMATICS: See McAllister (1963. Natl. Mus. Can. Bull. 191:1-53) for synonymy. Kluikanov (1970. Zool. Zh. 49:399-416) described osteology and placed *Thaleichthys* in its own new subfamily.



CA: Del Norte CO., Klamath River, 136 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Bodega Head, Sonoma Co., CA, to Nushagak River and Pribilof Islands, Bering Sea, AK. Adults live at moderate sea depths in echo-sounding layer not far from shore.

ADULT SIZE: 125-170 mm SL, 150-200 mm TL, maximum perhaps 300 mm TL.

BIOLOGY: Anadromous. Spawns in spring, eggs adhering to sand or pea gravel, and some adults survive spawning. Larvae hatch in two to three weeks, are carried to sea by currents, mature in third year, and may live to five. Feed on crustacea, preyed on by dog-

fish, white sturgeon, Pacific salmon, halibut cod, marine mammals, and sea birds. Important to Indians as source of oil and food. Dried and supplied with a wick it was used for lighting, hence its old name, candlefish. Hart and McHugh (1944. Bull. Fish. Res. Board Can. 64:1-27), Smith and Saalfeld (1955. Wash. Dep. Fish. Fish. Res. Pap. 1:3-26), and Barraclough (1964. J. Fish. Res. Board Can. 21:1333-37) provided life history information.

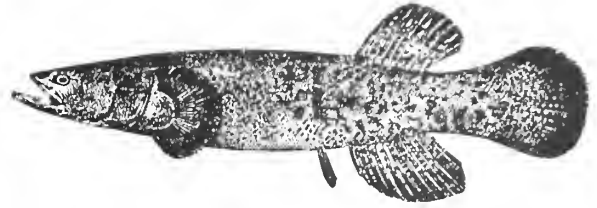
Compilers: D. E. McAllister and B. Parker.
September 1978.

Dallia pectoralis Bean
Alaska blackfish

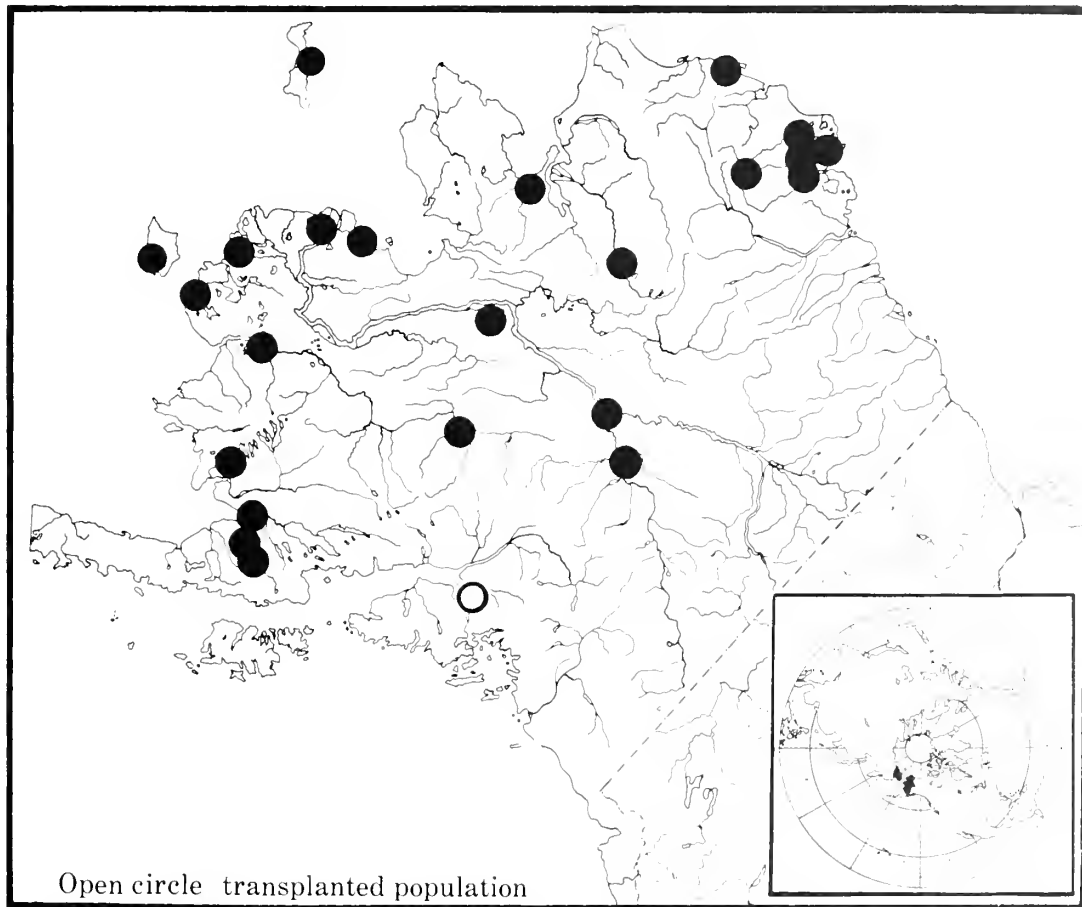
Order Salmoniformes
Family Umbridae

TYPE LOCALITY: St. Michael's, AK (Bean 1880. Proc. U.S. Natl. Mus. 2:353-59).

SYSTEMATICS: Monotypic genus. Sometimes placed in separate family Dalliidae.



AK: St. Michaels, ca. 18 cm SL
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Arctic and sub-Arctic fresh water in AK, north-eastern tip of Siberia, and Bering Sea Islands of St. Lawrence, St. Matthew, and Nunivak. Usually in weed-choked lowland swamps and ponds, occasionally in streams, rivers, and large lakes where vegetation is abundant (Scott and Crossman 1973. *Freshwater Fishes of Canada*).

ADULT SIZE: 50-165 mm, 330 mm maximum.

BIOLOGY: Spawns May to August, with rapid growth of young during first summer. Females carry from 100-300 eggs of two sizes and stages of development. Eggs demersal and adhesive. Maximum age estimated to be eight years. Feeds largely on insect larvae, ostracods, cladocerans, and snails (Scott and Crossman 1973).

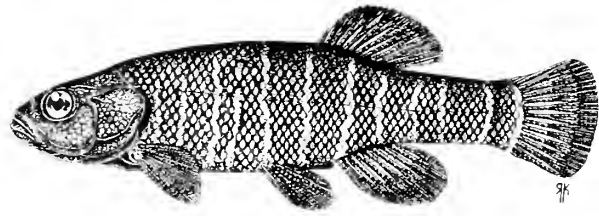
Compiler: F. C. Rohde, February 1978.

Novumbra hubbsi Schultz
Olympic mudminnow

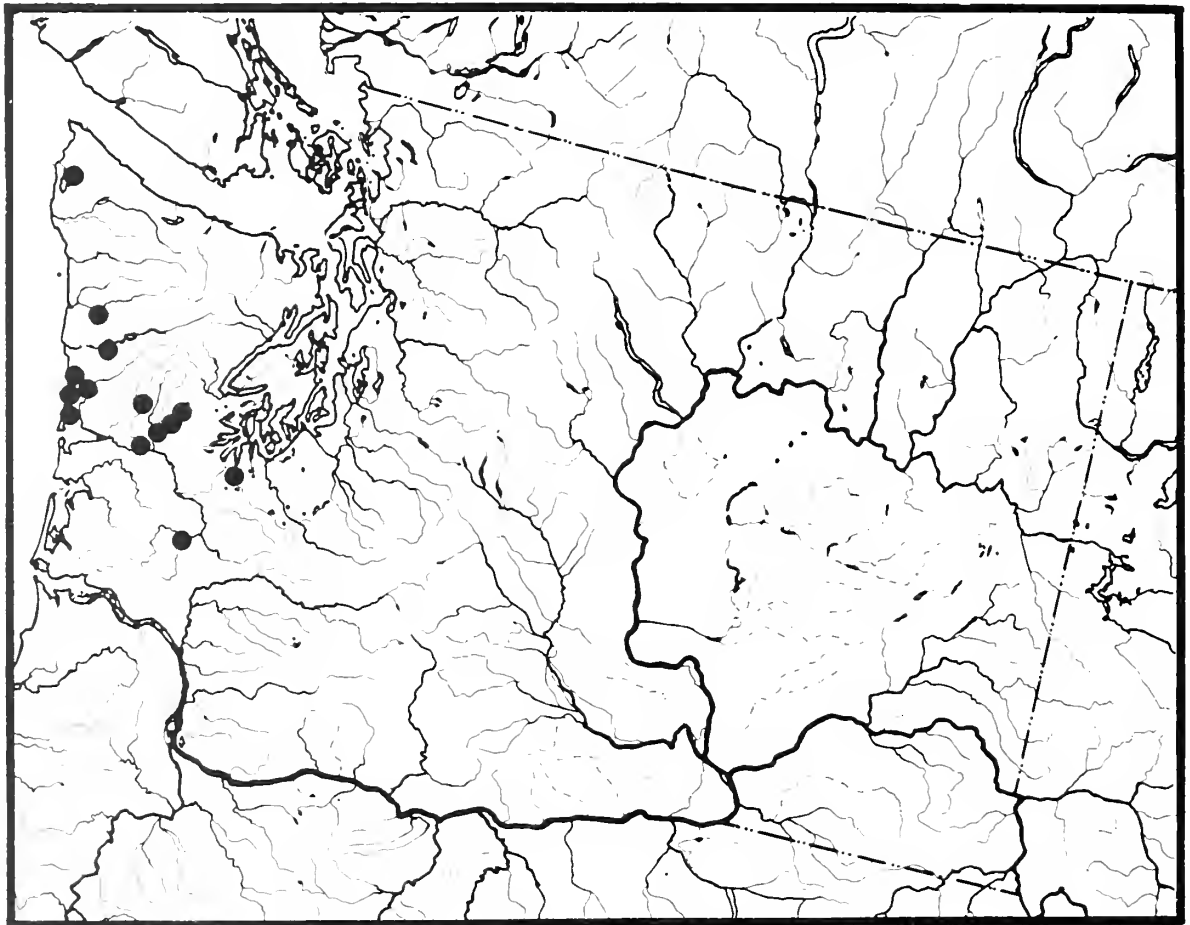
Order Salmoniformes
Family Umbridae

TYPE LOCALITY: Satsop River (Chehalis River drainage), Grays Harbor Co., Washington (Schultz 1929. Univ. Washington Publ. Fish. 2:73-81).

SYSTEMATICS: Apparently isolated from other living North American umbrid species for an extended period of time. An Oligocene fossil form, *N. oregonensis*, described from eastern OR (Cavender 1969. Occas. Pap. Mus. Zool. Univ. Mich. 660:1-33).



WA: Mason Co., Dry Run Creek, male, ca. 60 mm TL (NCSM).



DISTRIBUTION AND HABITAT: Confined to the Olympic Peninsula of WA. Known from lower Deschutes River, Chehalis River drainage, north along western base of Olympic Mountains to Queets River System; also in Ozette Lake. In quiet waters with considerable aquatic vegetation or other cover and mud or dark substrates. Populations are locally abundant but irregularly distributed. Changes area of habitation, but not habitat type, from summer to winter. Sexes aggregate in separate though similar habitats during spring and autumn.

ADULT SIZE: 40-70 mm SL.

BIOLOGY: Gravid females found from November-June, but most spawning occurs in spring (Meldrim 1968. Ph.D. diss., Univ. Washington; Hagen et al. 1972. Can. J. Zool. 50:1111-15). Males territorial. Fry have "gluing" glands on head and attach to vegetation. Food consists of ostracods, isopods, oligochaetes, mysids, molluscs, and dipterans.

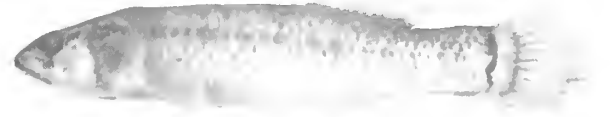
Compiler: J. W. Meldrim. April 1978.

Umbra limi (Kirtland)
Central mudminnow

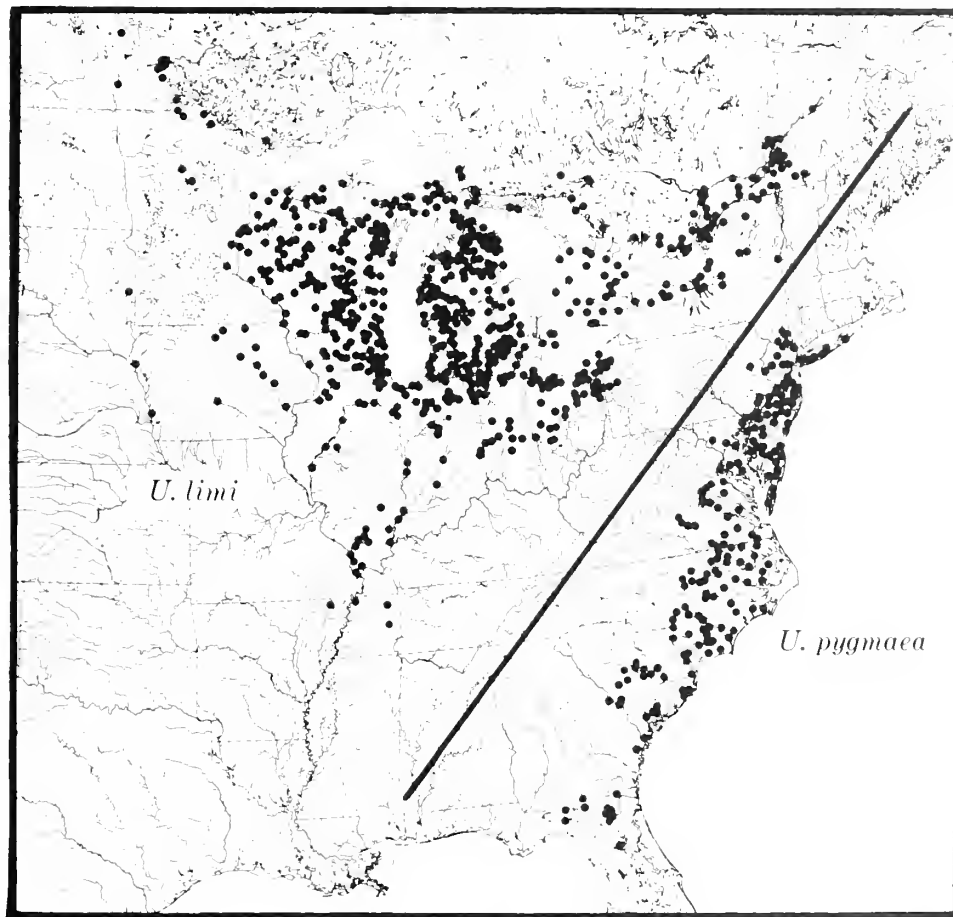
Order Salmoniformes
Family Umbridae

TYPE LOCALITY: "Heads of Yellow Creek, in the village of Poland, Trumbull Co., Ohio" (Kirtland 1841. Boston J. Nat. Hist. 3: 273-80).

SYSTEMATICS: No definitive systematic study of *Umbra* published. Most closely related to allopatric Atlantic slope species *U. pygmaea*. Third member of genus occurs in Balkan area of Europe. Dineen and Stokely (1954. Copeia: 169-79) described osteology, and Chapman (1934. J. Morphol. 56: 371-405) compared osteology to that of other umbrid species.



(NCSM)



DISTRIBUTION AND HABITAT: Southern Canada and central United States, from QU (east of Montreal) west throughout most of Great Lakes basin to upper Red River of North drainage in southern MB and extreme southwestern ON; south in Mississippi Valley to extreme western TN and eastern AR. In quiet, mud-bottomed, often heavily vegetated streams, sloughs and ponds, particularly along margins. Often common in more northerly parts of range, but sometimes hard to find because of secretive habits.

ADULT SIZE: 46-117 mm TL.

BIOLOGY: Peckham and Dineen (1957. Am. Midl. Nat. 58: 222-31) found *U. limi* in IN to be a carnivorous bottom feeder, primarily on small invertebrates (copepods, ostracods, cladocerans, and various insect larvae) and occasionally fishes. Spawning occurs in April in IN, correlated with flooding of areas adjacent to stream; rise in water temperature and forming of suitable breeding habitats stimulate spawning. Number of eggs per female ranges from 220-1500. May live to four years. Stokely and Dineen (1953. Copeia: 232-34) analyzed growth.

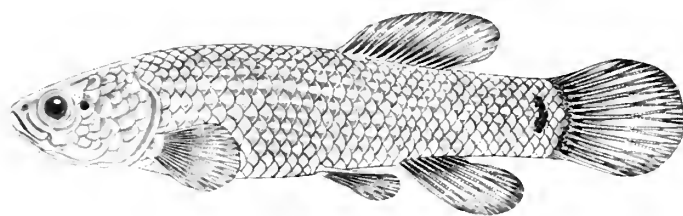
Compiler: C. R. Gilbert. April 1979.

Umbra pygmaea (DeKay)
Eastern mudminnow

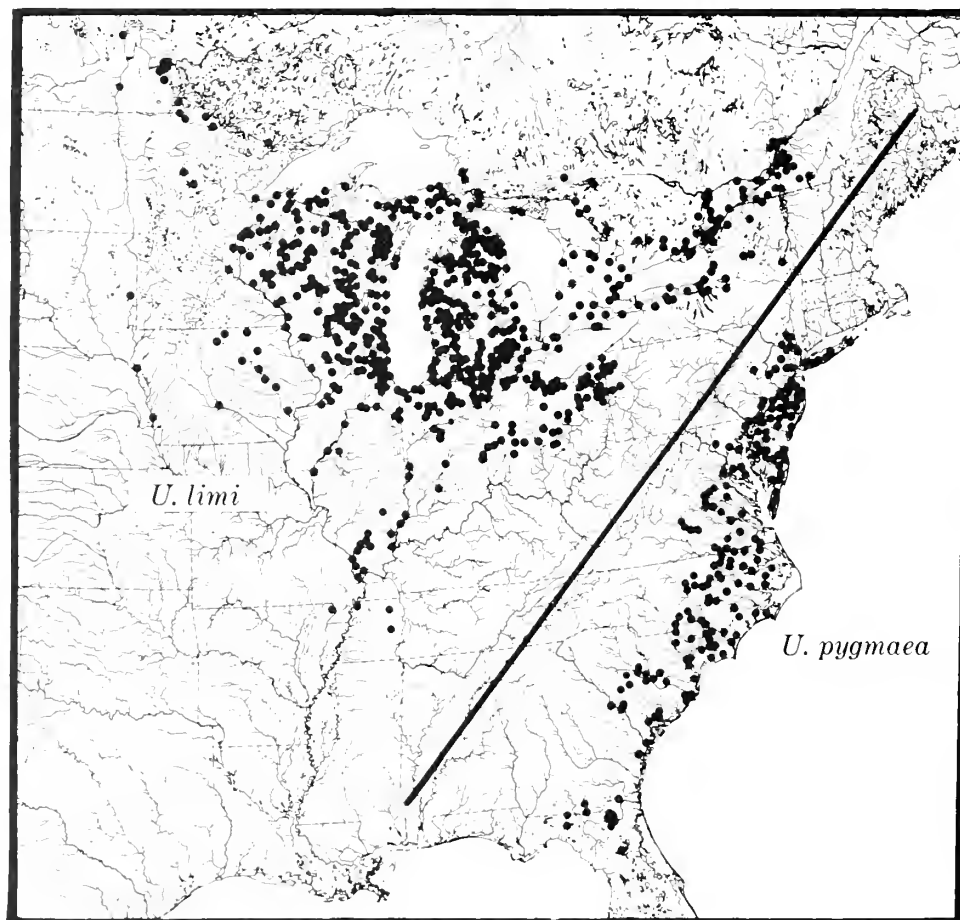
Order Salmoniformes
Family Umbridae

TYPE LOCALITY: Tappan, Rockland Co., NY (DeKay 1842. *Natural History of New York*, I. Zoology, 4. Fishes).

SYSTEMATICS: No definitive systematic study of *Umbra* published. Most closely related to allopatric central North American species *U. limi*. Third member of genus occurs in Balkan area of Europe. Chapman (1934. *J. Morphol.* 56:371-405) compared osteology of various umbrid species.



MD: Queen Anne's Co., Wye River (NCSM).



DISTRIBUTION AND HABITAT: South-eastern NY including Long Island, south (largely on Coastal Plain) to St. Johns River drainage, northeastern FL, west to Aucilla River drainage (on Gulf slope), FL and GA. In quiet, mud-bottomed, often heavily vegetated streams, sloughs and ponds, particularly along margins. Often common in central parts of range, more sporadic at peripheries.

ADULT SIZE: ca. 80 mm SL maximum.

BIOLOGY: No definitive studies. Basic aspects of biology presumably similar to those of *U. limi* (see account of that species).

Compiler: C. R. Gilbert. April 1979.

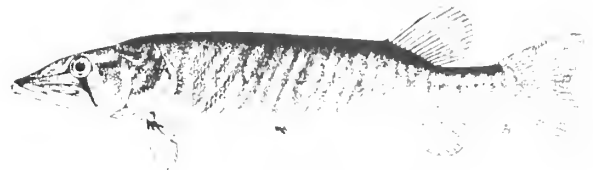
Esox americanus Gmelin
Redfin pickerel and Grass pickerel

TYPE LOCALITIES: *Esox a. americanus* (redfin pickerel), vicinity of New York City (Gmelin 1788. *Systema naturae*, Laurentii Salvii, Holmiae, 13 ed.) *Esox a. vermiculatus* (grass pickerel), tributaries of Wabash River near New Harmony, IN (Lesueur in Cuvier and Valenciennes 1846. *Histoire Naturelle des Poissons* 19).

SYSTEMATICS: Two separate species, *E. americanus* of east coast and *E. vermiculatus* of Mississippi River basin, suggested to be only subspecifically distinct (Crossman 1966. Copeia: 1-20), with intergradation over large area of southern part of range. Weed (1927. Field Mus. Nat. Hist. Zool. Leaflet 9: 153-204) suggested third subspecies *E. a. umbrosus*, in Great Lakes, now considered part of *E. a. vermiculatus*.

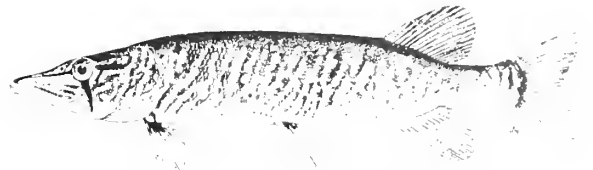
DISTRIBUTION AND HABITAT: *E. a. americanus* (open circles): Coastal Plain from MA to south NH, Lac St. Pierre (St. Lawrence River) region of QU, south in Hudson River to coastal NY, from east PA south to St. Mary's River system in GA. Waters from southwestern GA, south to Lake Okeechobee, FL, and Gulf of Mexico systems from Suwanee River, FL and GA, to Biloxi River, MS, appear to contain intergrades (half-open circles). *Esox a. vermiculatus* (closed circles): Pearl River, LA, west to Brazos River, TX, north through eastern OK, southeastern MO, east border of IA, to southeastern WI. East across southern MI and southern ON to tributaries of southwestern shore of Lake Ontario and those of Niagara River, western NY, including tributaries of Lake Ontario, some of the Finger Lakes and those of St. Lawrence, in ON and NY, as far downstream as mouths of Ottawa and Chateauguay rivers in QU. Eastern limit runs southwest from NY, west of mountains along line from northwestern PA to central MS, including Tennessee River in northwestern AL. Crossman (1978. Am. Fish. Soc. Spec. Publ. 11: 13-26) presented evidence of past extended distribution (including populations existing today in NB) and discussed fossils and isolated introductions in central ON, north WS, west PA, Chautauqua Lake, NY, MD, southwestern WA, CO, and CA. Both forms found in small, quiet, heavily vegetated waters like streams, drainage canals, ponds, and bays of small lakes. More often in streams than lakes. *E. a. americanus* often preferring acid habitats and *E. a. vermiculatus* basic to neutral ones. Not known from brackish water to the extent of *E. niger*.

Order Salmoniformes
Family Esocidae



E. a. americanus

QU: Godfrey River, male, 190 mm TL (Scott and Crossman 1973).



E. a. vermiculatus

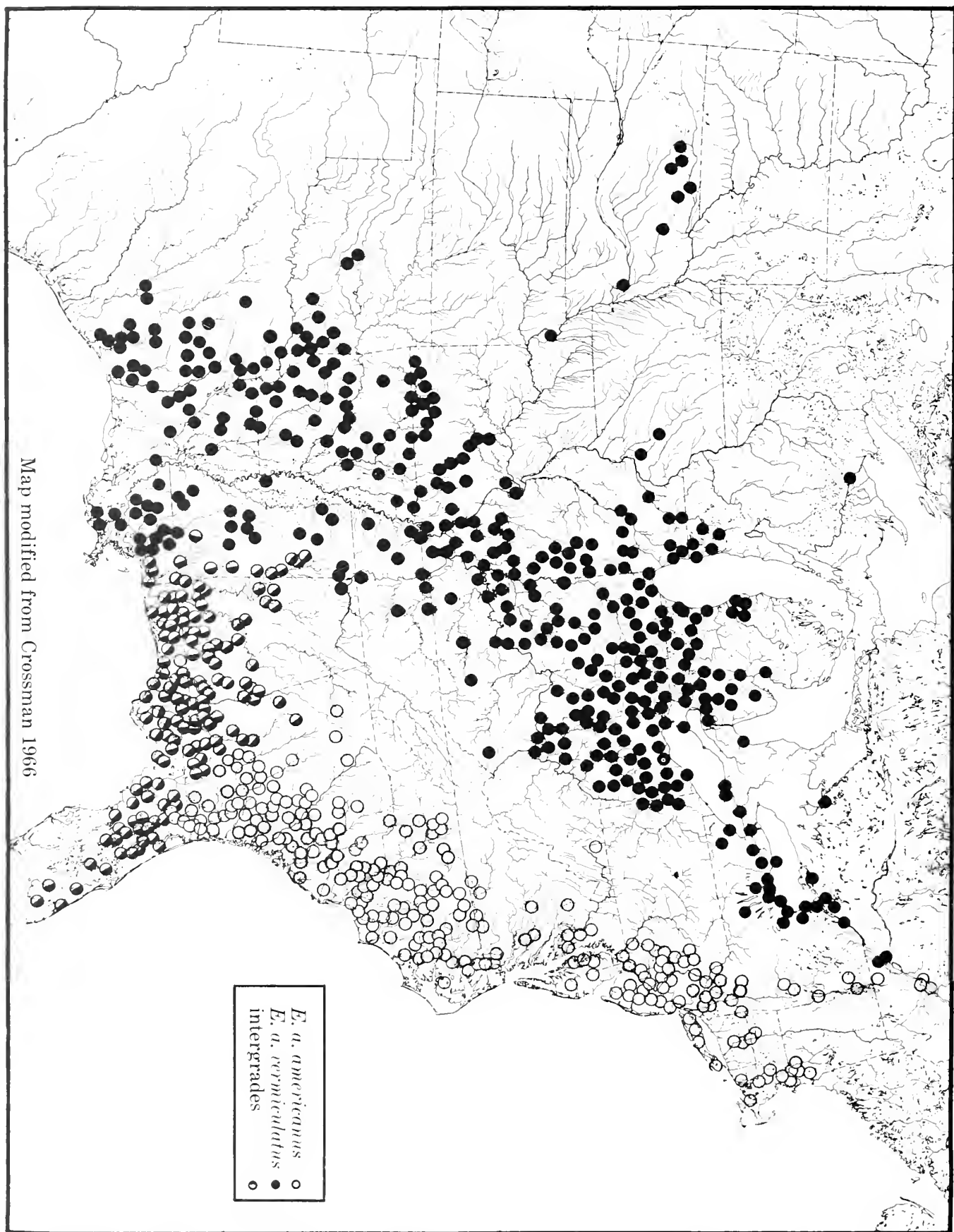
ON: Leeds Co., Jones Creek, male, 219 mm TL (Scott and Crossman 1973).

See map on next page

ADULT SIZE: Usually 250-300 mm TL, but recorded to 381 mm in OH.

BIOLOGY: Both subspecies are spring spawners, but both also reported to spawn in fall; the two periods probably coincide with water temperatures of ca. 10°C. No nest, parental care, or defense of territory. Moderately large number of small demersal, adhesive eggs. Sexually mature by at least age two, life expectancy seven to eight years. Food changes with size: cladocerans, immature insects, then fishes, but crayfish and invertebrates always small part of diet. Hybridizes in nature with *E. niger* and *E. lucius*. Literature on complex very limited. For various aspects of biology of pair see Buss (1962. Penn. Fish. Comm. Spec. Purp. Rept.: 1-12) Crossman (1962. Copeia: 114-23), Crossman (1962. R. Ont. Mus. Life Sci. Contrib. 55:1-29), Kleinert and Mraz (1966. Wis. Cons. Dept. Tech. Bull. 37: 1-40), Crossman (1966), and Ming (1968. Okla. Fish. Res. Lab. Contrib. 171: 1-66).

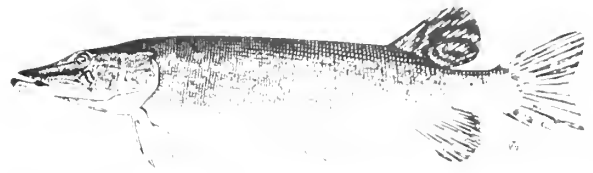
Compiler: E. J. Crossman. June 1979.



Distribution of redfin pickerel, *Esox a. americanus*, and grass pickerel, *Esox a. vermiculatus*

Esox lucius Linnaeus
Northern pike

Order Salmoniformes
Family Esocidae



(Scott and Crossman 1973).



See map on next page

TYPE LOCALITY: Europe (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Summarized by Crossman (1978. Am. Fish. Soc. Spec. Publ. 11: 13-26). Holarctic species, exhibiting wide phenotypic variation throughout range.

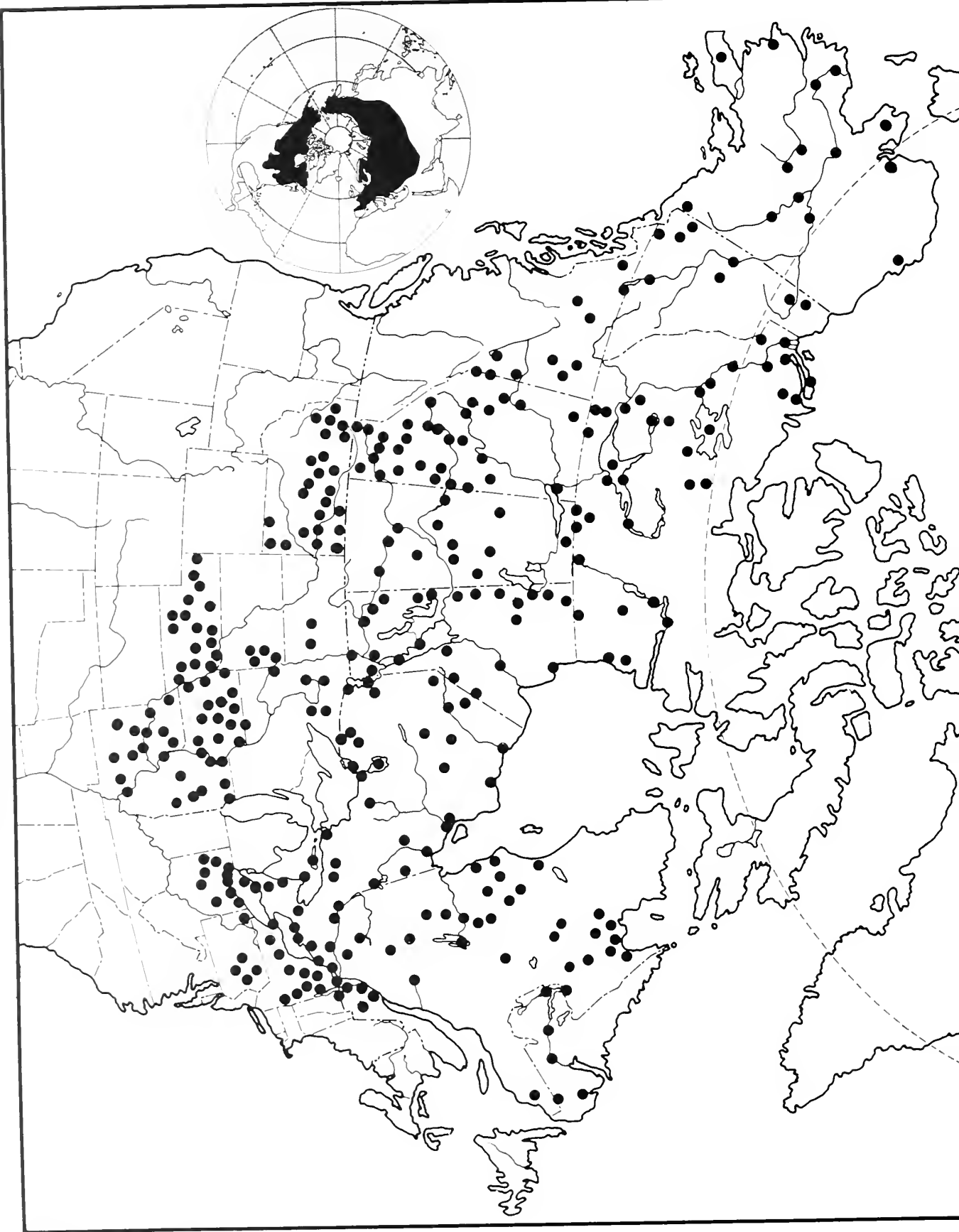
DISTRIBUTION AND HABITAT: Holarctic, from northwestern Europe, across northern Asia, to northern North America. In North America, extends from southern Labrador (absent on northeast coast) and eastern Ungava (absent on Hudson Bay coast north of Leaf River), south along north shore of St. Lawrence River and south on west side of Appalachian Mountains. Present east of mountains only in Connecticut River (including VT) and Hudson River systems and in PA; south through OH, and southwest to southern MO, northwest to western MT, north east of the Rocky Mountains, but including extreme northern BC, to include most of AK excluding Aleutian Islands and the crescent south of the Alaska Range (but present near Yakutat on the upper Panhandle), east across all of Canada to Hudson Bay, missing only on the Arctic Coast from eastern Coronation Gulf to Hudson Bay. Native range once extended west in MT. More recent introductions include territory to east, south, southeast and southwest of native range (see Crossman 1978). Habitat usually small lakes; shallower, more vegetated areas of larger lakes; marshes; and to lesser extent rivers. Of five species in family, has greatest tolerance for cold environments and only species to extend into Arctic. World distribution used to suggest intolerance for brackish water, but occurs regularly in Baltic Sea.

ADULT SIZE: Usually 500-700 mm TL, but known to reach at least 133.3 cm TL.

BIOLOGY: Spring spawner (4-11°C) in north, arriving near spawning grounds under ice; no nest, defense of territory, or parental care. Large number of small demersal, adhesive eggs. Adults solitary except at spawning, sexes similar (Casselman 1974. Trans. Am. Fish. Soc. 103: 343-47) except for dimorphic growth and life expectancy (females larger and older). Sexual maturity in first to third year, life expectancy at least 24 years. Food changes with size from plankton to invertebrates, then almost entirely fishes and other vertebrates. Hybridizes in nature with grass pickerel, and with muskellunge to produce popular form known as "norlunge" or "tiger musky." Found also as unspotted color variant called "silver pike" once thought to be a muskellunge. For summaries see Buss (1961. Penn. Fish. Comm. Spec. Purp. Rept.:1-58), Threinen et al. (1966. Wisc. Cons. Dept. Publ. 235: 1-16), Toner and Lawler (1969. FAO Fish. Syn. 30 Rev. 1:1-39).

Compiler: E. J. Crossman. June 1979.

Distribution of northern pike, *Esox lucius*



Esox masquinongy Mitchill
Muskellunge

Order Salmoniformes
Family Esocidae

TYPE LOCALITY: Lake Erie (Mitchill 1824. Mirror:297) is traditional citation of original description, but DeKay (1842. Nat. Hist. New York, Part 4. Fishes: 1-415.) is oldest available firsthand account of that description.

SYSTEMATICS: Originally confused and interchanged with *E. lucius*. Gradually recognized as separate species under such names as *E. estor*, *E. nobilior*, and finally *E. masquinongy*, and later considered to comprise three species (*E. masquinongy*, *E. ohioensis*, and *E. immaculatus*), subsequently reduced to subspecies no longer considered nameworthy (Crossman 1978. Am. Fish. Soc. Spec. Pub. 11: 13-26). Hybridizes with *E. lucius*. Hybrid, not to be confused with early records of individuals referred to as silver muskellunge (see account of *E. lucius*), known as "tiger musky" or "norlunge" and reared in hatcheries.



ON: Kenora, Hogan's Pond,
male, 663 mm TL (Scott and
Crossman 1973).



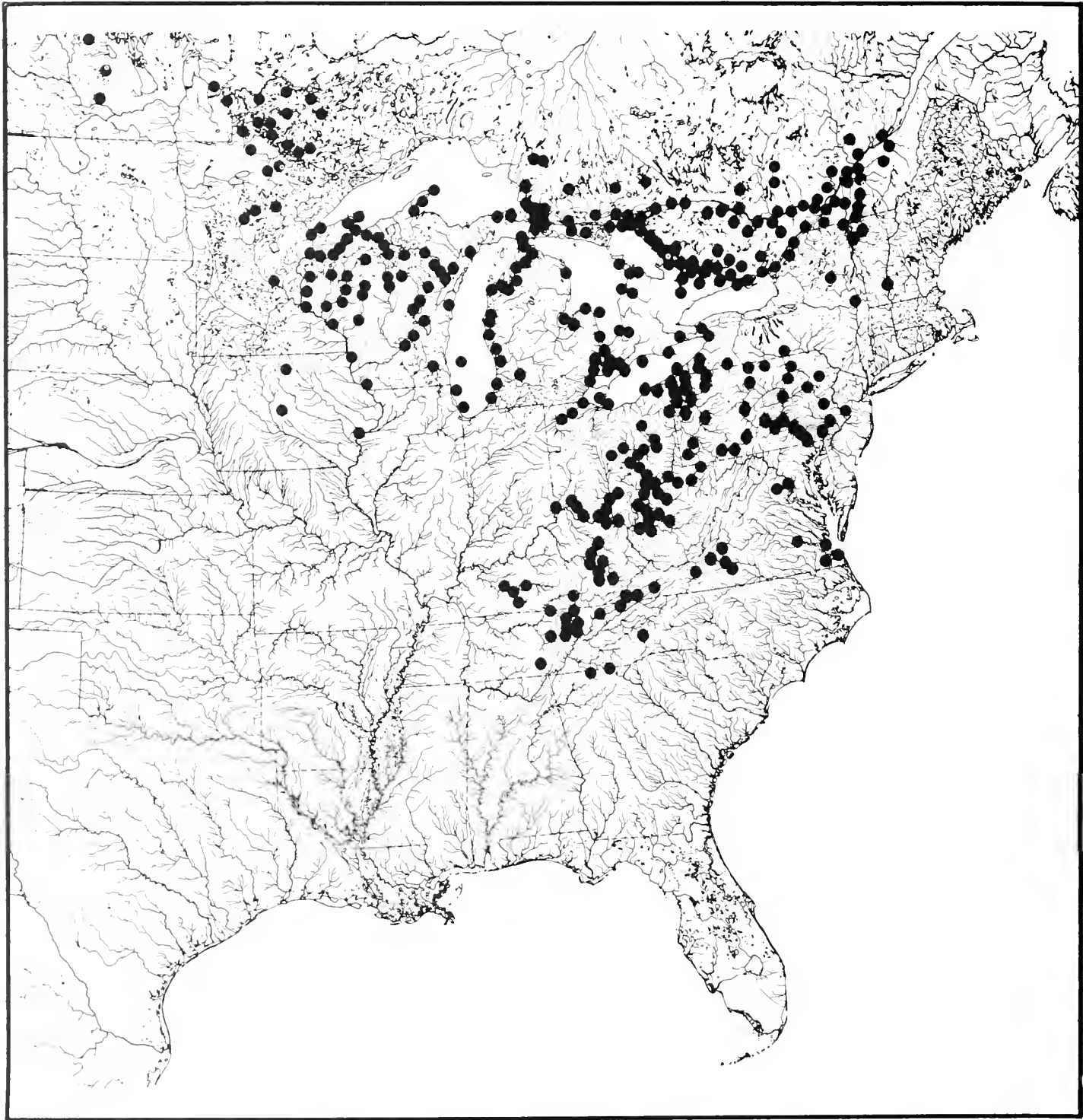
See map on next page

DISTRIBUTION AND HABITAT: Native distribution probably originally restricted to area west of Appalachian Mountains, from QU and ON south to TN. Presently occurs from St. Lawrence River and northern tributaries, south in Lake Champlain-Hudson River system, and in Connecticut River (introduced?), east of mountains through NY and PA to western NC and northern GA (rare). West of mountains extends from southern QU, southeastern ON, Great Lakes except Lake Superior, south in Mississippi basin to Tennessee River in northern AL (rare), west from Lake Michigan south to central IA and north to MN, southwestern, and southeastern MB. Populations east of mountains in NY and PA result from early introductions or extensions, those in VA from recent ones, those in headwater streams of Tennessee River in NC (French Broad River) and GA (Toccoa River, and Lake Chatuge) probably had natural origin. Introduced in MB west of Lake Winnipeg, but populations east of that Lake apparently recent natural extension from English River, ON. Extensive introductions starting as early as late 1800's make it difficult to delineate native range (see Crossman 1978). Habitat from very shallow, heavily-vegetated, warm water to 12 m depth along rocky shorelines (larger adults). Rarely far from cover. More often in slow meandering streams and larger rivers than *E. lucius*.

ADULT SIZE: Now usually 68 - 122 cm TL. Angling record presently 163.8 cm TL.

BIOLOGY: Spawns in spring when water temperatures are 9.4-15°C. In certain years movement toward very shallow spawning grounds starts as ice is breaking up but usually after *E. lucius* has spawned. No nest built nor parental care provided. Large number of small, demersal, adhesive eggs hatch in 8-14 days at 11.7-17.2°C. Sexes similar, with dimorphism only in growth, size, and longevity. Sexual maturity reached by third to fifth year and maximum life span probably 25 years. Large adults normally sedentary and solitary. Food changes with size—plankton, larger invertebrates, and finally large fishes and other vertebrates such as muskrats, ducks, etc. Cannibalistic at least to two years of age. For summaries of life history and biology see Johnson et al. (MS 1957. Comm. Handb. Biol. Data:1-6) and Buss (MS 1960. Penns. Fish Comm. Spec. Purpose Rept.:1-14). For bibliography of available literature see Crossman and Goodchild (1978. R. Ont. Mus. Life Sci. Misc. Publ.: 1-131).

Compiler: E. J. Crossman. June 1979.



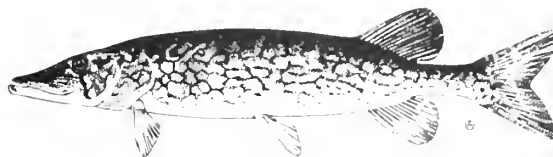
Distribution of muskellunge, *Esox masquinongy*

Esox niger Lesueur
Chain pickerel

Order Salmoniformes
Family Esocidae

TYPE LOCALITY: Philadelphia, PA (market) (Lesueur 1818. J. Acad. Nat. Sci. Phila. 1:413-17).

SYSTEMATICS: As recently as 1964 Atlantic coastal populations said to differ from Mississippi Valley populations. Names *E. reticulatus* and *E. crassus*, respectively, used in past for those segments, but recent unpublished study (McNeil 1978. Royal Ontario Museum) found no consistent differences.



ON: Lake Champlain, female
409 mm TL (Scott and
Crossman 1973).



See map on next page

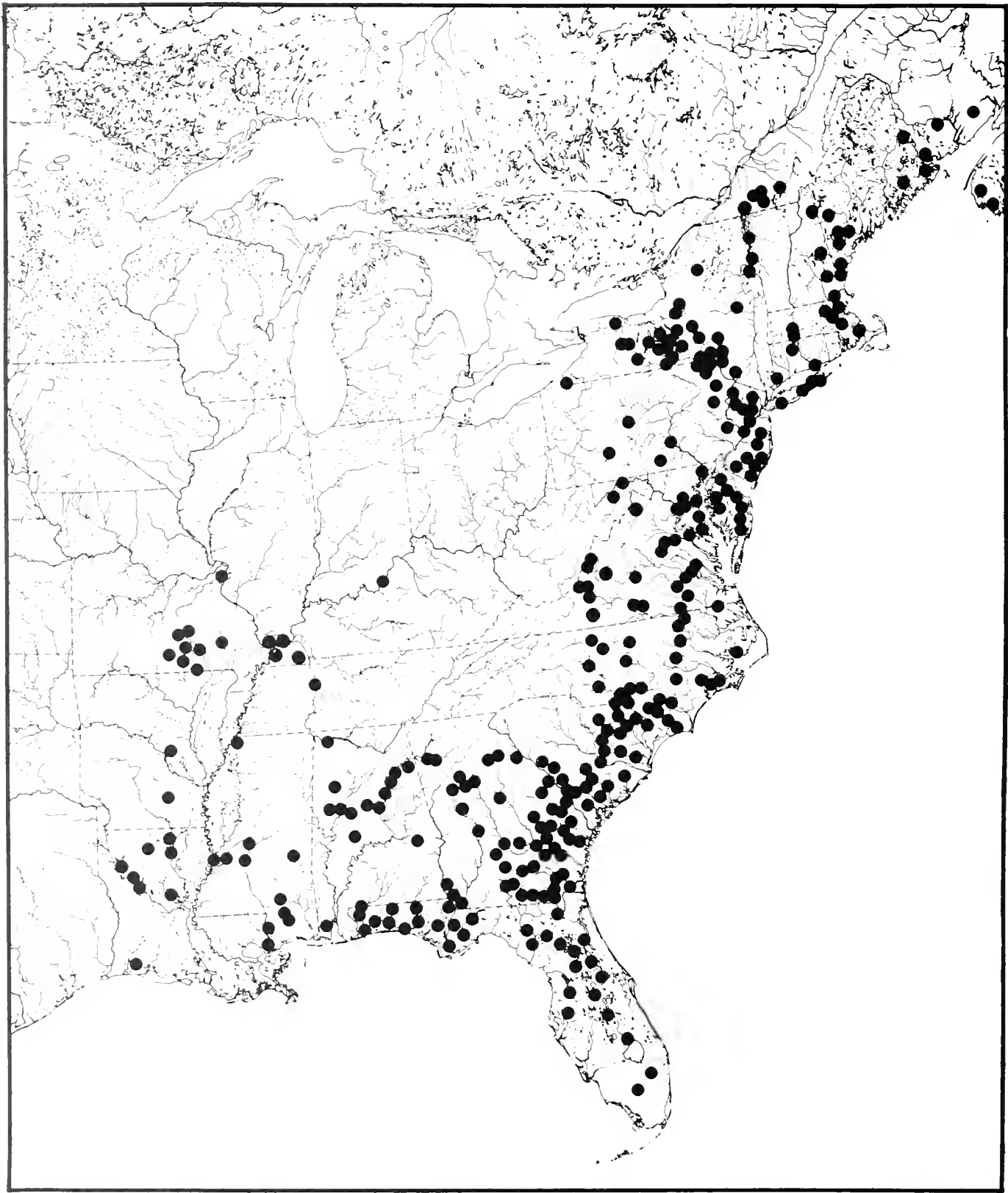
DISTRIBUTION AND HABITAT: Primarily native to, and most abundant on, Atlantic Coastal Plain (but native populations exist above Fall Line), Gulf of Mexico drainages and north to MO and KY in Mississippi drainage. Past, native range given as southwest ME, south on east side of Green Mountains to Crooked Lake, Orange Co., FL, west to Mammoth Springs and other tributaries of White River in AR. Primary current occurrence from Yarmouth and Digby cos. south in NS through southern NK and southern MA, west to eastern townships of QU, south from NY (including tributaries of Lake Ontario) through northwestern WV, to at least Everglade Canals and Lake Okeechobee in FL, west through most of Gulf states to Navasota River in TX, and north through eastern AR to southeastern MO and southwestern KY. Limited popularity as game fish has not led to extensive introductions outside native range. Present populations in NS, NK, QU, eastern MA, VT, and FL south of Lake Okeechobee result of introductions or extensions of range made possible by man-made waterways. Also introduced in Lake Erie system of NY; Long Lake, OH; eastern IA; northern KY; and eastern MN, NB, and CO. Populations on TX-OK border may be introduced or relict (see Crossman 1978. Am. Fish. Soc. Spec. Pub. 11:13-26 for fossil records and range

extensions). Variable habitat, from clean, shallow, heavily vegetated shoal water, to deeper parts of lakes, to larger mountain streams. More often in lakes and ponds. Successful in waters with temperatures up to 35°C, pH to 3.8, and salinities to 22 ppt.

ADULT SIZE: 381-457 mm TL, angling record 787 mm FL.

BIOLOGY: Spawns late winter to spring (some may spawn in fall), usually 8.3°-11.1°C. No territory defended, no nest built, no parental care provided young. Large number of small, demersal, adhesive eggs scattered over vegetation or detritus. Sexes similar, sexual maturity reached in first to fourth year, and maximum life span probably eight to nine years. Food taken changes with increases in size: plankton, to larger invertebrates, to finally fish and other vertebrates (infrequently including mice, salamanders, frogs, and tadpoles). Strongly cannibalistic under certain conditions. Hybridizes readily with redbfin pickerel, *E. americanus*, and northern pike, *E. lucius*. For summaries see Lewis (1961. M.Sc. thesis, West Virginia Univ.), and McCabe (1958. Nat. Acad. Sci. Comm. Handb. Biol. Data: 1-45); for bibliography see Crossman and Lewis (1973. Roy. Ontario Mus. Life Sci. Misc. Publ: 1-81).

Compiler: E. J. Crossman. June 1979.



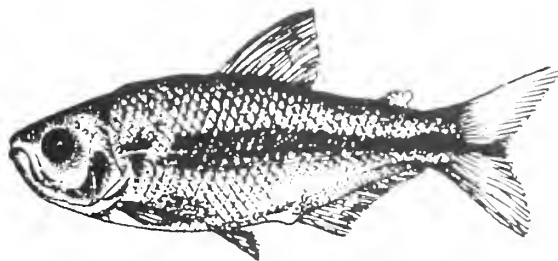
Distribution of chain pickerel, *Esox niger*

Astyanax mexicanus (Filippi)
Mexican tetra

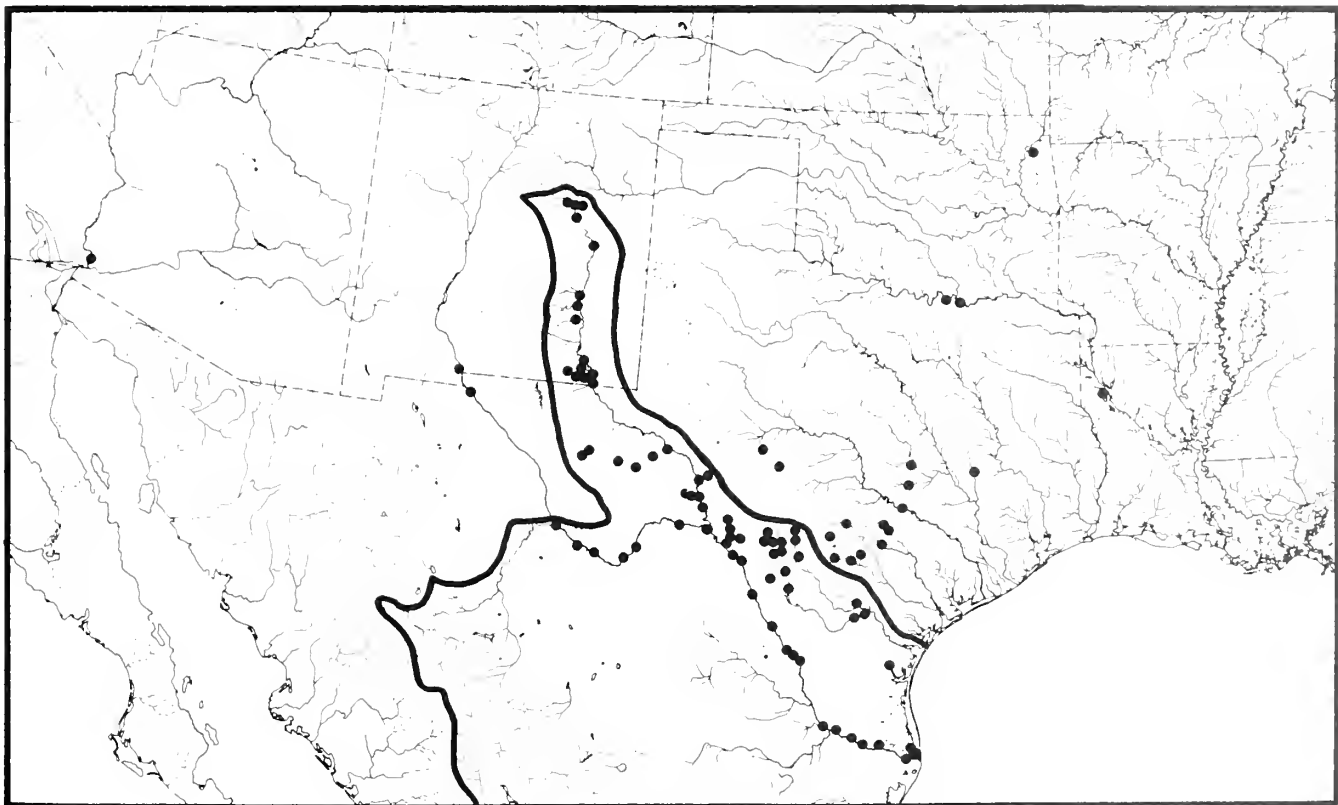
Order Cypriniformes
Family Characidae

TYPE LOCALITY: Mexico (Filippi 1853. Rev. Mag. Zool. [Ser. 2] 5:166).

SYSTEMATICS: Previously considered a subspecies of *A. fasciatus*, an interpretation still held by some (Alvarez 1970, *Peces mexicanos*). Relationships between this and troglitic populations in Mexico is controversial although evidence suggests that all are conspecific (Avisé and Selander 1972, Evolution 26:1-19; Kirby et al. 1977, Copeia:578-80).



TX: Bexar Co., San Antonio River, 79 mm SL (F. Birkhead).



Line separates native from introduced populations

DISTRIBUTION AND HABITAT: The only native characin, originally restricted to lower Rio Grande, Pecos, and Nueces river drainages in southern TX (Brown 1953, Tex. J. Sci. 5:245-51). Range has since been extended, largely through use as bait throughout southwest. Established in Edwards Plateau Region in central TX, where particularly abundant in constant temperature springs and their outflows. Koster (1957, *Fishes of New Mexico*) reported it from Pecos River as far north as central NM and from Rio Grande in extreme southwestern edge of the state. Collected from such widely separated localities as lower Colorado River in southwestern AZ; Red River in and adjacent to Lake Texoma along TX-OK border; Cross Lake in Red River drainage near Shreveport, LA; and Neosho River drainage at Lake Spavinaw

in northeastern OK. Occurs in variety of stream and river habitats. Most abundant in pool areas where they travel singly or in moderate-sized schools (Darnell 1962, Pub. Inst. Mar. Sci. 8:299-365).

ADULT SIZE: 50-100 mm SL.

BIOLOGY: Apart from the study by Edwards (1977, Copeia: 770-71), who found that in TX, the species migrated seasonally to escape low winter water temperatures, it has remained virtually unstudied in the United States. Populations in northeastern Mexico are omnivorous, with higher plant remains filamentous algae and aquatic insects comprising bulk of diet. Spawning probably occurs during late spring (Darnell 1962; Birkhead unpubl. data).

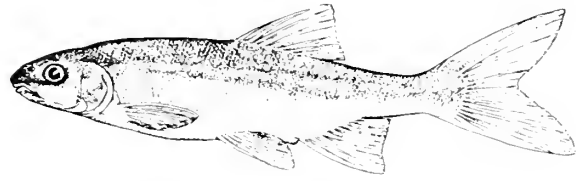
Compiler: W. S. Birkhead, December 1978.

Acrocheilus alutaceus Agassiz and
Pickering
Chiselmouth

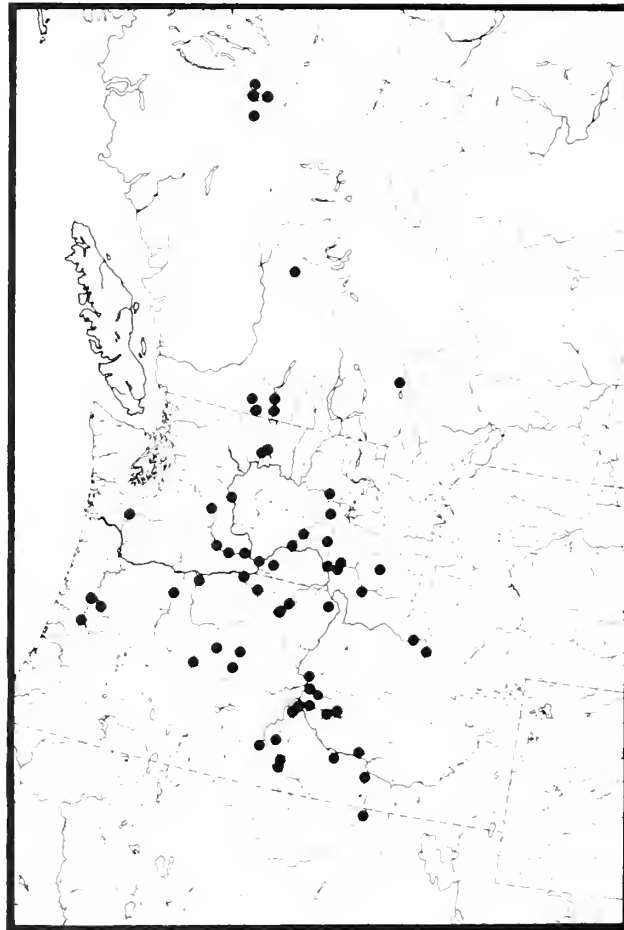
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Willamette Falls and Walla Walla River, OR (Agassiz and Pickering in Agassiz 1855. Am. J. Sci. Arts 19:71-99).

SYSTEMATICS: Only living species in genus. An extinct species, *A. xestes*, described from fossil remains from Plio-Pleistocene Lake Idaho, Owyhee Co., southwestern ID (Miller and Smith 1967. Occas. Pap. Mus. Zool. Univ. Mich. 654:1-24). Patten (1960. Copeia: 71-73) reported hybridization between this species and *Ptychocheilus oregonensis*.



(La Rivers 1962).



DISTRIBUTION AND HABITAT: Mainly stream-dwelling and confined to western drainage systems of Columbia (below Shoshone Falls) and Fraser rivers and Harney basin of central OR. Inhabits slow-flowing streams of nearly all sizes but also occurs in lakes (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Summary of early distribution records in Schultz and DeLacy (1935-1936. J. Pan-Pac. Res. Instit.:365-380; 63-78; 127-142; 211-226; 275-290).

ADULT SIZE: 150-200 mm SL.

BIOLOGY: Specialized feeder, scraping algae and diatoms from bottom substrate. Moodie (1966. M.S. thesis, Univ. British Columbia) reported on age, spawning, fecundity, and feeding in a BC population. Bangham and Adams (1954. J. Fish. Res. Board Can. 11:673-708) and Hoffman (1967. *Parasites of North American Freshwater Fishes*) described parasites.

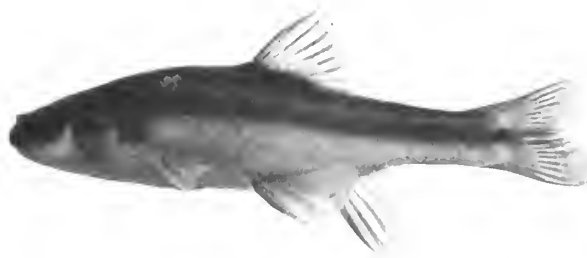
Compiler: R. L. Wallace. June 1978.

Agosia chrysogaster Girard
Longfin dace

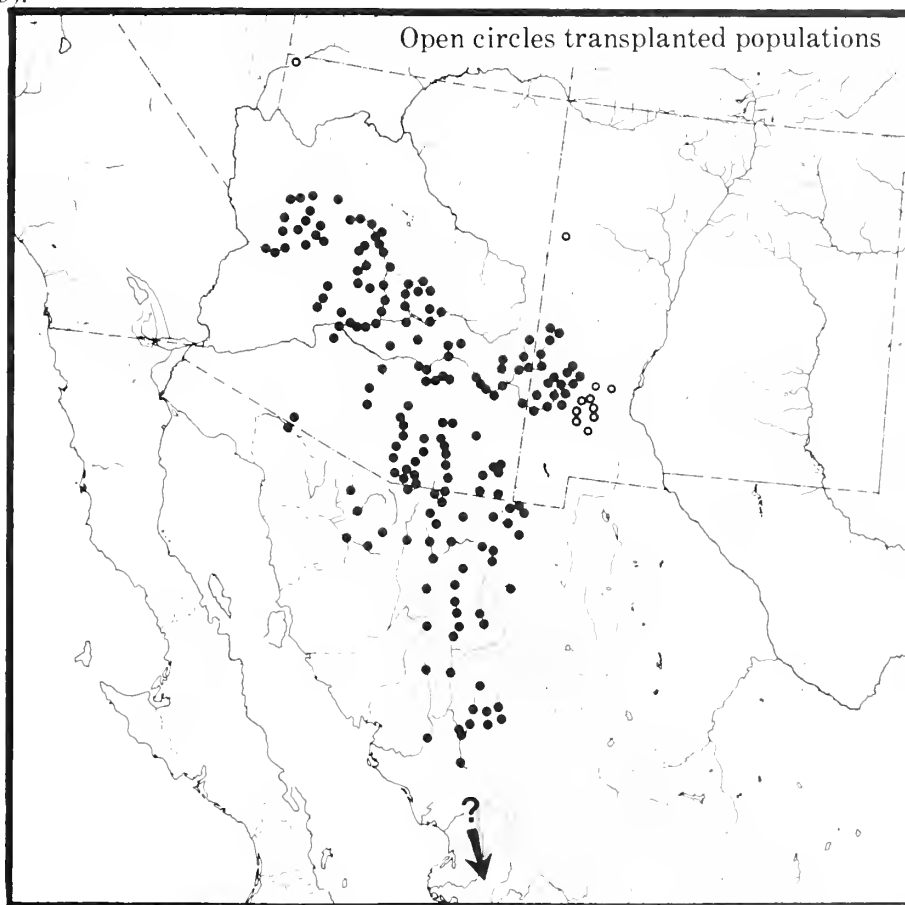
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio Santa Cruz, Sonora, Mexico (presumably near Nogales, AZ; ca. 31° 20' N, 110° 40' W) (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Monotypic genus, presumably related to *Rhinichthys*-like stock of western cyprinids. Mexican populations often considered distinctive, undescribed form (Miller 1958. *Zoogeography*. Am. Assoc. Adv. Sci. Publ. 51:187-222; McNatt 1974. Proc. West. Assoc. State Game Fish Comm. 54:273-79).



NM: Catron Co., Tularosa Creek, 67 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Streams of desert and grassland, through chaparral and into lower montane forests, generally below 1500 m elevation in north but ranging to 2000 m south. Common throughout Bill Williams and Gila rivers, south in coastal streams of western Sonora, Mexico, west of Sierra Madre Occidental in Rio Yaqui basin, Sonora, and to Rio Sinaloa, Mexico. Southern limit of range ill defined. Introduced and established in Mimbres, and recorded from but apparently not established in Zuni River, NM (Koster 1957. *Guide to the Fishes of New Mexico*), Virgin River, AZ, and Rio Grande, NM (Minckley 1973. *Fishes of Arizona*). Found in shallow runs over sand bottom and in eddys and shallow

pools near overhanging banks or other cover. Typically in moderate current; rarely in backwaters or deep pools (Minckley and Barber 1971. *Southwest. Nat.* 15:459-64).

ADULT SIZE: Rarely exceeds 100 mm SL.

BIOLOGY: Spawns throughout year (orig. data) in saucer-shaped depressions in fine sand. Young hatch in less than four days in summer (Minckley 1973). Feeds on algae, aquatic insects, and detritus, and plays role of opportunistic omnivore in desert stream habitats (Schreiber 1978. M.S. thesis, Arizona State Univ.).

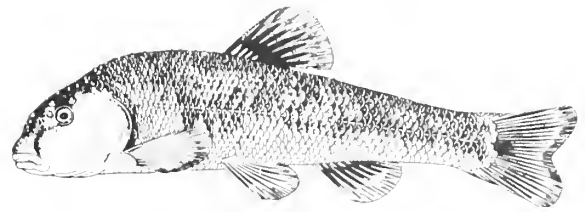
Compiler: W. L. Minckley, July 1979.

***Campostoma anomalum* (Rafinesque)**
Stoneroller

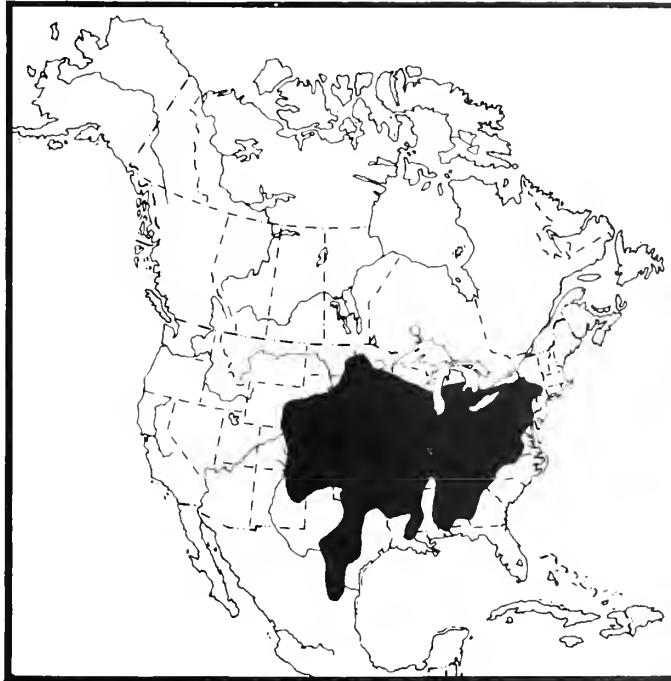
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Licking River, KY (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Closest relative probably *C. oligolepis*. Highly variable species that has been described over 15 times. Certain populations appear to be recognizable at subspecific levels (Burr 1976. *Chic. Acad. Sci. Nat. Hist. Misc.* 194:1-8; Buth and Burr 1978. *Copeia*:298-311). Thorough analysis of variation throughout the range is needed to determine status of certain populations and names that apply to them.



IL: Kendall Co., Big Rock Creek, male, 133 mm SL (Burr and Smith 1976. *Copeia*: 521-31).



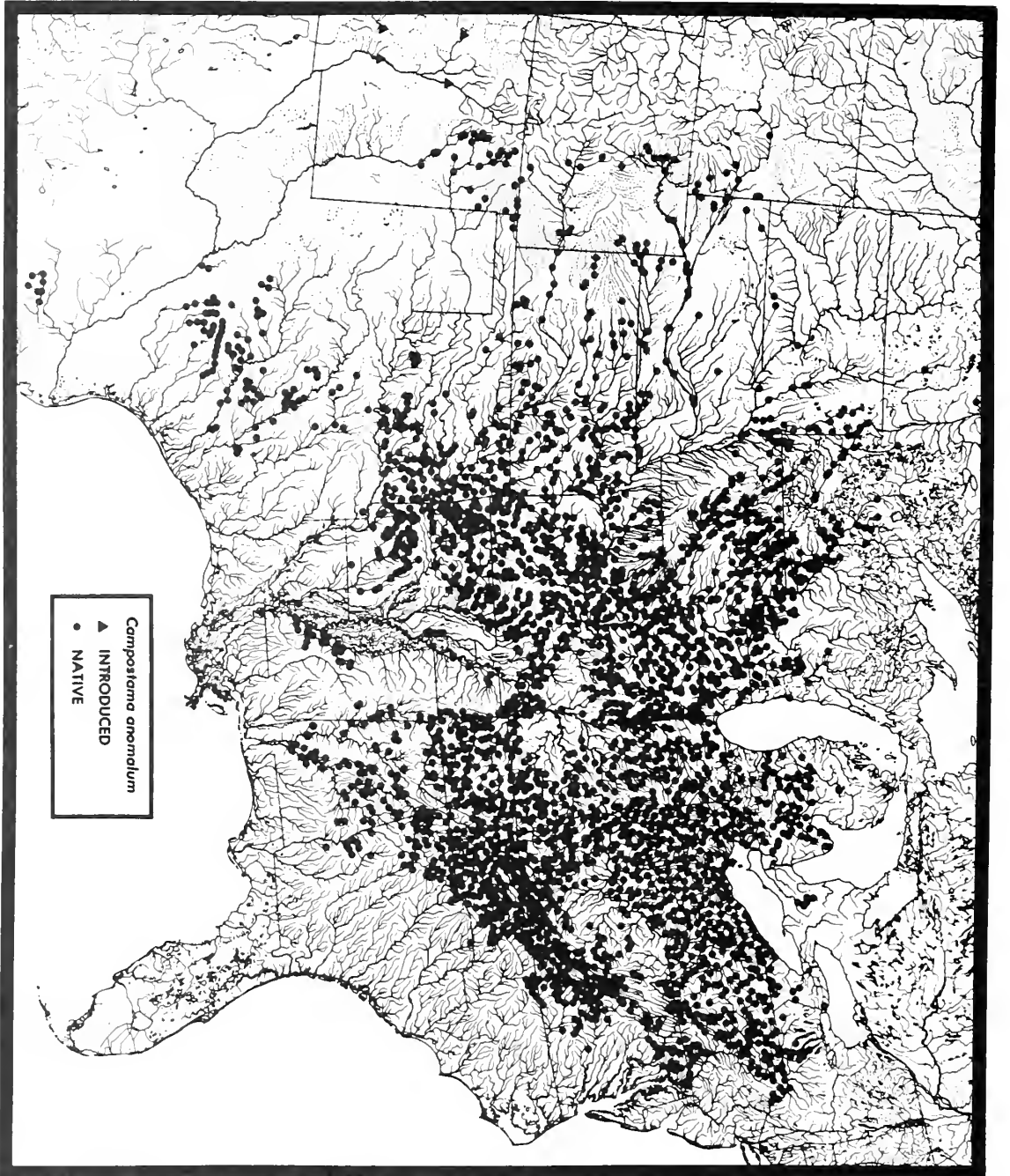
See map on next page

DISTRIBUTION AND HABITAT: Widespread and ubiquitous throughout much of central and eastern United States, extending as an isolated population into Rio San Juan, Mexico. Sporadic in Red River of North drainage and on Great Plains. Recently discovered in smaller tributaries of Thames River, ON. Characteristic of small to medium-sized streams with clear, cool water a moderate, sometimes rapid current, gravel or rubble bottom, and pools or riffles. Breeding individuals often found in pools adjacent to riffles. Tolerant of turbid, silty waters. Usually very common.

ADULT SIZE: 70-230 mm SL.

BIOLOGY: Forbes and Richardson (1908. *The Fishes of Illinois*) and Kraatz (1923. *Ohio J. Sci.* 23:265-83) reported food habits. Early development studied by Reed (1958. *Copeia*:325-27). Lennon and Parker (1960. *Trans. Am. Fish. Soc.* 89:263-70) analyzed growth. Hoffman (1967. *Parasites of North American Freshwater Fishes*) listed parasites, and Cloutman (1976. *Southwest. Nat.* 21:67-70) analyzed parasites in two species of *Campostoma*. Hankinson (1927. *Trans. Ill. State Acad. Sci.* 12:132-50), Cahn (1927. *Ill. Biol. Monogr.* 11:3-151), and Miller (1962. *Copeia*:407-17) studied nest building and reproductive behavior. General summaries by Cross (1967. *Handbook of Fishes of Kansas*) and Pflieger (1975. *The Fishes of Missouri*).

Compiler: B. M. Burr. May 1978.



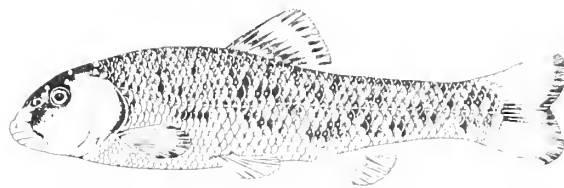
Distribution of stoneroller, *Campostoma anomalum*

***Campostoma oligolepis* Hubbs
and Greene**
Largescale stoneroller

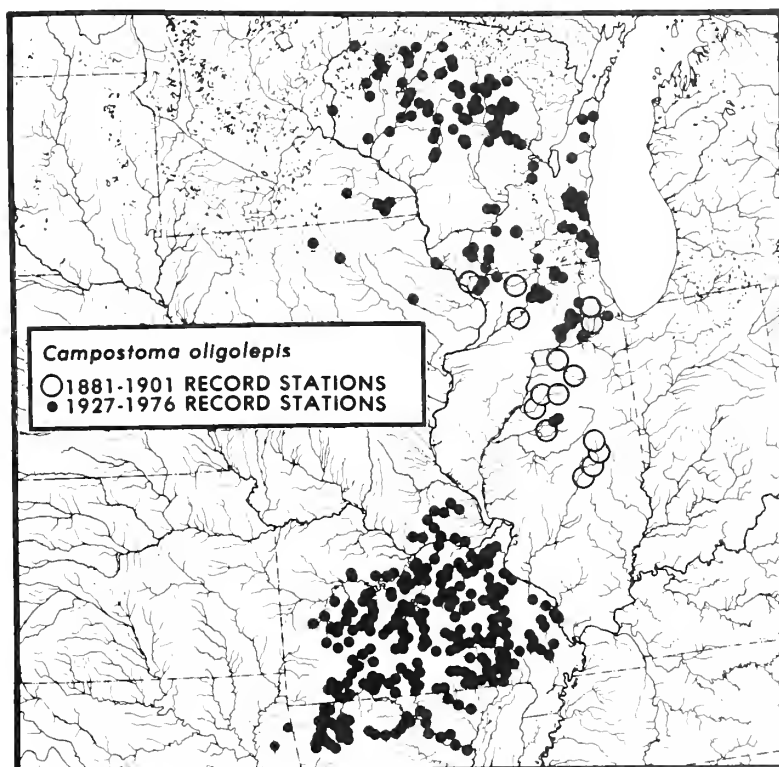
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Little Rib River, 4.02 km e of Hamburg, Marathon Co., WI (Hubbs and Greene 1935. Trans. Wis. Acad. Sci. Arts Lett. 29:89-96).

SYSTEMATICS: Considered valid species by most recent workers (Pflieger 1971. Univ. Kans. Publ. Mus. Nat. Hist. 20:225-570; Burr and Smith 1976. Copeia:521-31; Cloutman 1976. Southwest. Nat. 21:67-70). Based on isozyme patterns Buth and Burr (1978. Copeia:298-311) showed that syntopic populations of *C. oligolepis* and *C. anomalum* share several variant alleles, possibly a result of introgressive hybridization.



IL: Kendall Co., Big Rock Creek, male, 133 mm SL (Burr and Smith 1976).



Map modified from Burr and Smith 1976

DISTRIBUTION AND HABITAT: Primarily upper Mississippi River basin, some Lake Michigan tributaries and Ozark Upland region of MO and AR. Relict or introduced populations recently discovered in Illinois River, OK (Burr, Cashner, and Pflieger 1979. Southwest. Nat., in press). Formerly known from several localities in central IL. Characteristic of large or medium-sized streams with clear, cool water, moderate to swift current, and a gravel bottom. Shows preference for deep, fast riffles. Intolerant of siltation.

ADULT SIZE: 70-170 mm SL.

BIOLOGY: Cloutman (1976. Southwest. Nat. 21:67-70) analyzed parasites. Food habits, growth and reproductive characteristics are probably much like those of *C. anomalum*. Overall summary by Pflieger (1975. *The Fishes of Missouri*).

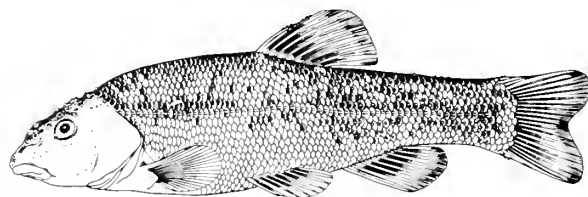
Compiler: B. M. Burr. February 1978.

***Campostoma ornatum* Girard**
Mexican stoneroller

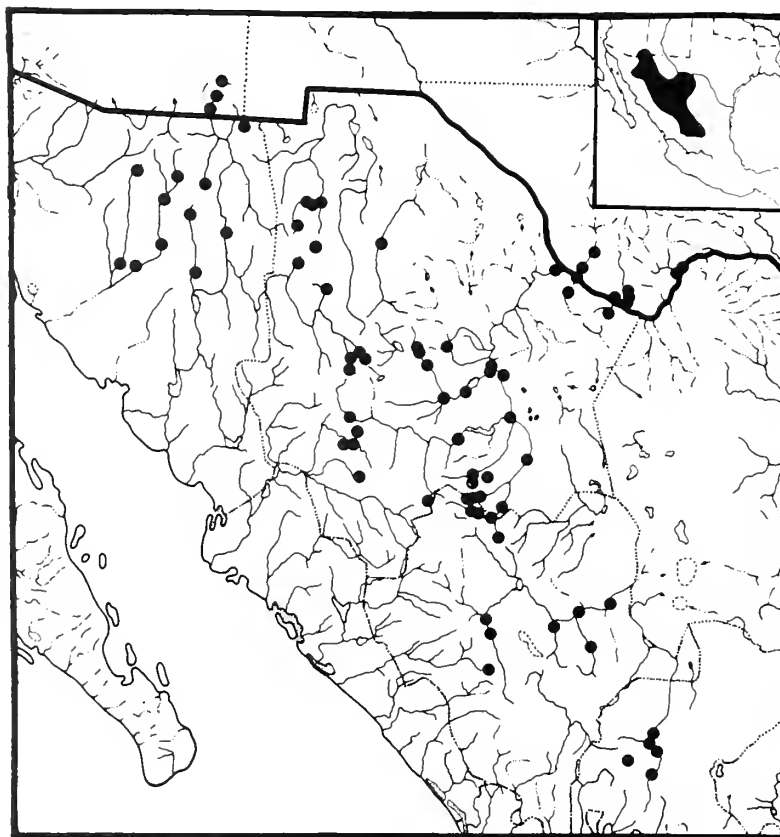
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Chihuahua River and a tributary a few miles long, Mexico (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8: 165-213).

SYSTEMATICS: Closest relative *C. anomalum*. Highly variable species displaying a number of presumably primitive features for the genus (Burr 1976. Trans. San Diego Soc. Nat. Hist. 18:127-43). Set off from other species of *Campostoma* by numerous morphological and biochemical characteristics (Buth and Burr 1978. Copeia :298-311).



Durango: Rio Nazas, male, 92 mm SL (Burr 1976).



Map modified from Burr 1976

DISTRIBUTION AND HABITAT: Big Bend region TX, west to Rio Sonora, Sonora, and south to Rio Aguanaval, Zacatecas. Common in Chihuahuan desert region. Occurs primarily in clear, fast riffles, chutes and pools in small to medium-sized creeks with gravel or sand bottoms.

ADULT SIZE: 55-110 mm SL.

BIOLOGY: Population fluctuations discussed by Hubbs and Wauer (1973. Southwest. Nat. 17:375-79). Growth and nests reported by McNatt (1974. Proc. West. Assoc. State Game Fish Comm. 54:273-79). Brief summary of parasites, food, and spawning dates by Burr (1976. Trans. San Diego Soc. Nat. Hist. 18: 127-43).

Compiler: B. M. Burr. February 1978.

Carassius auratus (Linnaeus)
Goldfish

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Chinese and Japanese waters; introduced into Japan (Linnaeus 1758, *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Two subspecies, *C. a. auratus* (Asia) and *C. a. gibelio* (eastern Europe); sometimes considered a subspecies of *C. carassius* (i.e. *C. c. auratus*). Hybridization and backcrossing occurs with *Cyprinus carpio*; hybrids common in western Lake Erie and in streams and canals in Chicago area (Trautman 1957, *The Fishes of Ohio*; Smith 1979, *The Fishes of Illinois*).



MD: Frederick Co., Potomac River, 91 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Native distribution — Eastern Europe to China. Collected from every state and three Canadian provinces (BC, AT, and ON). Abundant and well established at some North American localities. However, occurrences are often sporadic; in many areas this may reflect continued releases and escapements rather than established populations. Establishment in Manse Spring, Nye Co., NV, was a major reason for original decline in *Empetrichthys latos latos* population. Primarily found in still, often oxygen-deficient waters with thick vegetation. Introductions due to distribution by U.S. Fish Commission, escapes from hatcheries, outdoor ponds, and releases of aquarium fish and unused bait.

ADULT SIZE: Depends on environmental conditions, in United States usually 120-220 mm SL, 300 mm SL maximum.

BIOLOGY: Omnivorous with preference for phytoplankton; young tending to feed more on zooplankton and insect larvae. Adhesive eggs laid over submerged vegetation. Larval development illustrated by Mansueti and Hardy (1967, *Development of Fishes of the Chesapeake Bay Region*). Extensive literature on reproduction reviewed by Breder and Rosen (1966, *Modes of Reproduction in Fishes*).

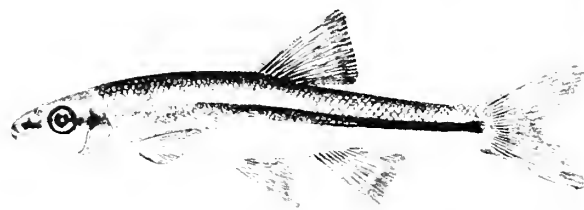
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

***Clinostomus elongatus* (Kirtland)**
Redside dace

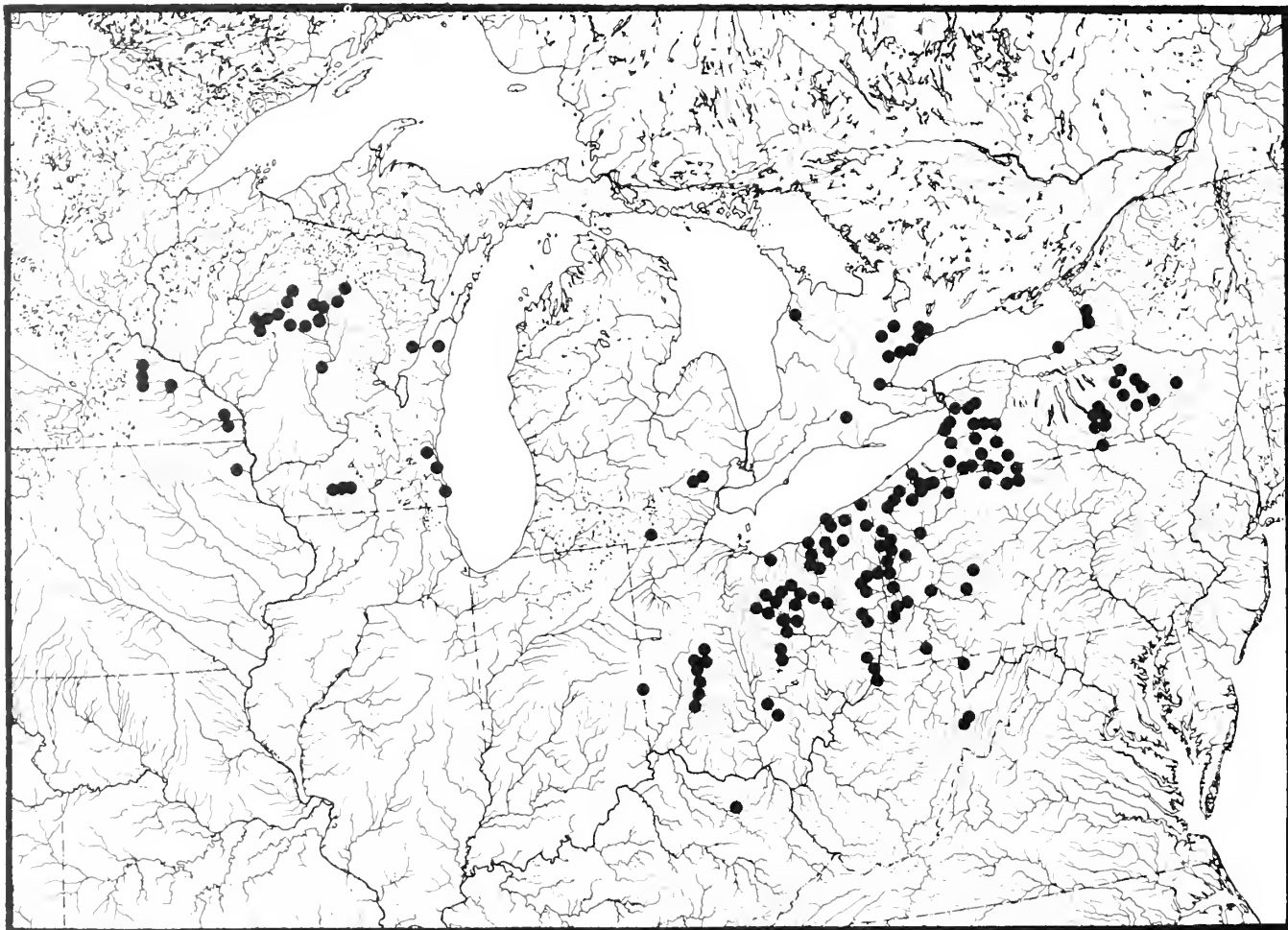
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Mahoning River, OH, and Lake Erie, near Cleveland (Kirtland 1838. Ann Rept. Geol. Surv. Ohio 2:157-97).

SYSTEMATICS: One of two species of *Clinostomus*. Genus apparently most closely related to western North American *Richardsonius*, in which the two species have sometimes been placed (Bailey in Harlan and Speaker 1951. *Iowa Fish and Fishing*: 189-238). Definitive systematic study of species not yet published.



MD: Garrett Co., Bear Creek,
50 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upper Susquehanna River drainage of NY and PA, Lake Ontario drainage of southern ON and NY, and upper Ohio basin of PA and NY, west through lower Great Lakes and upper Mississippi River basins to IA (where now extirpated) and MN. Range discontinuous and comprises several rather widely disjunct populations. May be locally common, but overall is rather rare. In recent years has disappeared from many areas. Inhabits small to medium-sized, cool, clear, rubble and gravel-bottomed streams, where it typically occurs in pools.

ADULT SIZE: 80 mm SL maximum.

BIOLOGY: Koster (1939. Copeia: 201-08) and Schwartz and Norvell (1958. Ohio J. Sci. 58:311-16) studied food habits, reproduction, and growth in NY and PA, respectively. Spawns in latter half of May in NY, in riffles or shallow, flowing pools. Food consists almost entirely of insects, particularly terrestrial forms, taken at surface. Individuals live three and sometimes four years.

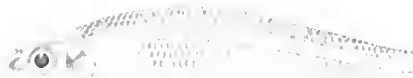
Compiler: C. R. Gilbert. August 1978.

Clinostomus funduloides Girard
Rosyside dace

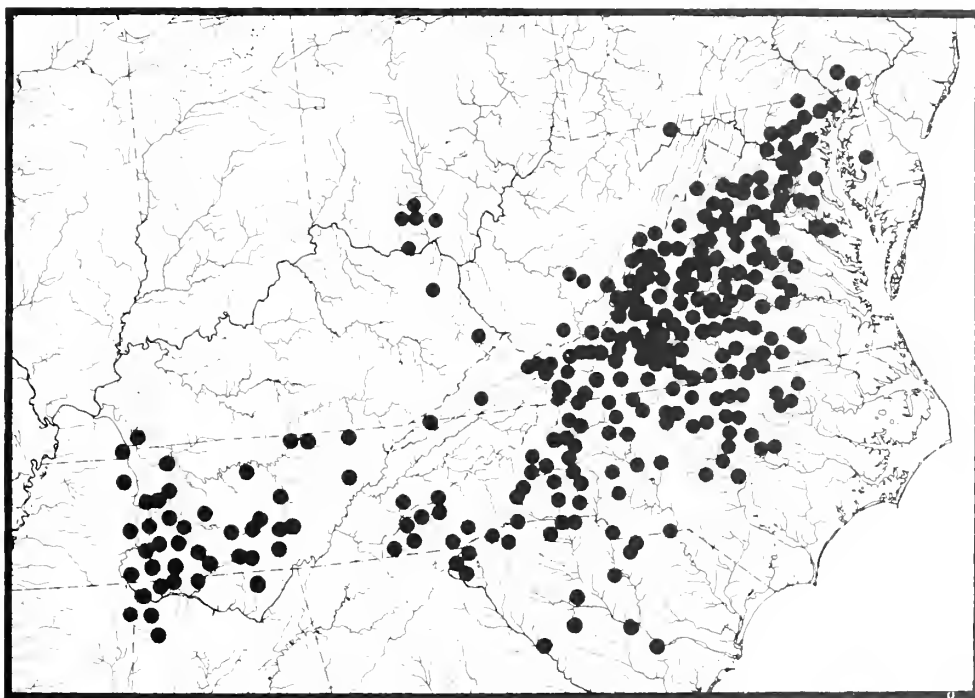
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Potomac River, Washington, D. C. (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Deubler (1955. Ph.D. diss., Cornell Univ.) recognized three distinct subspecies (two described), with the undescribed form close to species status. Lachner and Deubler (1960. Copeia: 358-60) clarified nomenclature of species, formerly called *C. vandoisulus*.



MD: Carroll Co., Beaver Run,
77 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upland Atlantic slope drainages from lower Delaware River to upper Savannah River. West of Appalachian divide, discontinuously distributed in tributaries of Ohio River in WV and OH, and Tennessee and Cumberland rivers in KY and TN. Deubler (1955) considered one subspecies to occupy upper Little Tennessee and Savannah river drainages, a second in rest of Tennessee and Cumberland drainages, and the third to occupy remainder of range. Upper Tennessee drainage, VA, records may represent introductions of *C. f. funduloides*. Typically inhabits clear to frequently turbid, small to medium-sized streams with moderate current. Usually common.

ADULT SIZE: 53-80 mm SL, 93 mm SL maximum.

BIOLOGY: Breder (1920a. Copeia: 35-38; 1920b. Copeia: 87-90) studied life history. Breder and Crawford (1922. Zoologica 2: 288-327) and Flemer and Woolcott (1966. Chesapeake Sci. 7:75-89) examined food habits, and Davis (1972. Chesapeake Sci. 13:63-66) reported on age, growth, and fecundity.

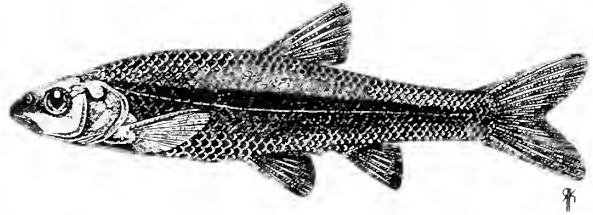
Compilers: C. R. Gilbert and D. S. Lee.
June 1978.

***Couesius plumbeus* (Agassiz)**
Lake chub

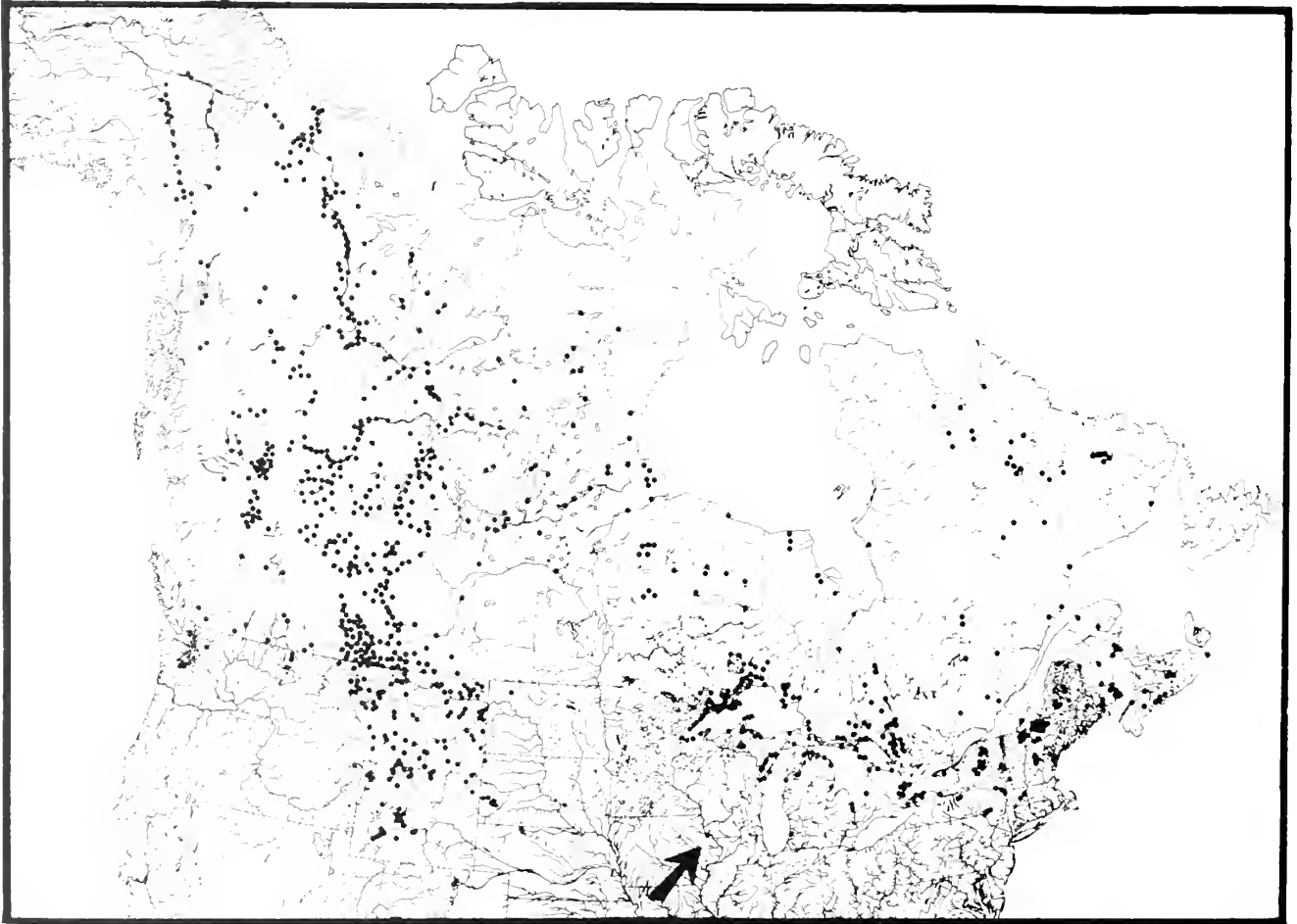
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Northern shore of Lake Superior (Agassiz 1850. *Lake Superior*).

SYSTEMATICS: Formerly included in *Hypopsis* (Bailey in Harlan and Speaker 1951. *Iowa Fish and Fishing*: 185-237) and more recently with *Semotilus* (Raney 1969. *Conservationist* 23:22-29; Jenkins and Lachner 1971. *Smithson. Contrib. Zool.* 90:1-15). Three subspecies have been recognized: *C. p. greeni* of Fraser and upper Columbia systems, *C. p. dissimilis* of Missouri basin, and *C. p. plumbeus* from Atlantic slope to Mackenzie Delta (Lindsey 1956. *J. Fish. Res. Board Can.* 13:759-89).



MN: Cook Co., Reservation
River, 102 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upper Columbia, Peace, Fraser, and upper Yukon systems in western United States and Canada. Widespread throughout Mackenzie and Hudson Bay drainages, Great Lakes region, and northern Atlantic slope drainages south to upper Delaware River. Scattered localities in Missouri and Platte drainages, with single collection from upper Mississippi system in IA. Several local populations at southern extremes of range may be extinct. Found in variety of habitats, but in Missouri basin and southern AT occurs more commonly in rivers and streams than in lakes.

ADULT SIZE: 60-100 mm SL, maximum 227 mm TL.

BIOLOGY: Usually migrates from lakes to streams in spring for spawning among rocks. Attains five years in age. Inhabits deeper parts of lakes in summer, and feeds on insect larvae, zooplankton and algae. Preyed on by lake trout, burbot, walleye, pike, mergansers, and kingfishers. Brown et al. (1970. *J. Fish. Res. Board Can.* 27:1005-15) investigated breeding biology. Bruce and Parsons (1976. *Fish. Mar. Serv. Res. Tech. Rep.* 683:1-13) analyzed age, growth and maturity.

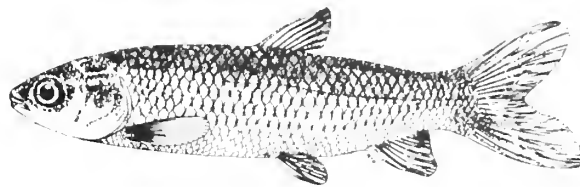
Compiler: A. W. Wells. September 1978.

Ctenopharyngodon idella Valenciennes
Grass carp

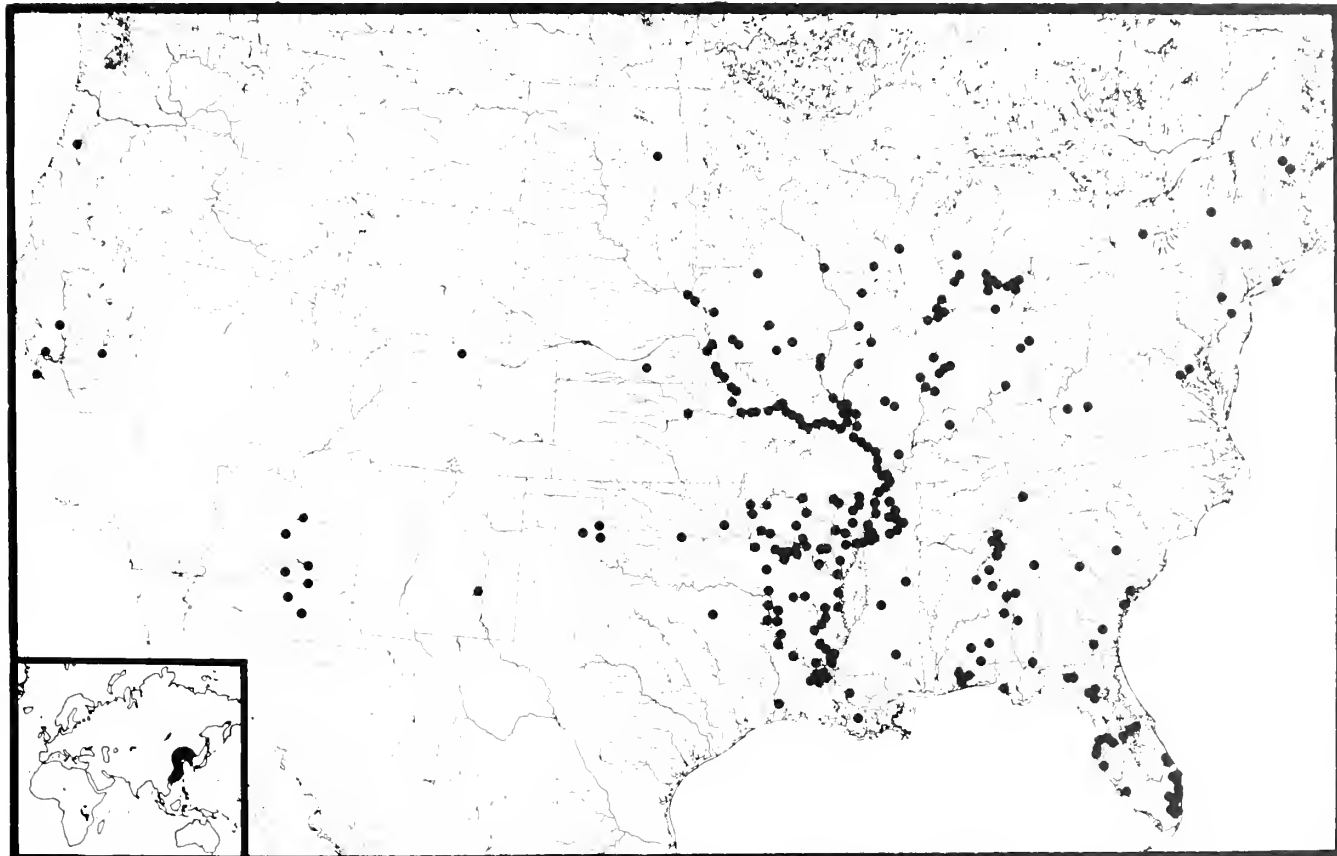
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: "China" (Valenciennes in Cuvier and Valenciennes 1844. *Histoire Naturelle des Poissons* 17:1-497).

SYSTEMATICS: In monotypic genus *Ctenopharyngodon*. Related to *Aristichthys nobilis* and *Hypophthalmichthys molitrix*.



AL: Lee Co., Auburn Univ.
experimental ponds,
168 mm SL (FAU).



DISTRIBUTION AND HABITAT: Native to Pacific slope of Asia from Amur River of China and Siberia south to West River in southern China and Thailand, where it inhabits low gradient stretches of large rivers. Introduced into the United States in 1963 at Auburn, AL, and Stuttgart, AR. Spread rapidly as a result of widely scattered research projects, agency stockings to solve aquatic weed problems, interstate importation by individuals from private hatcheries, and natural dispersal from stocking sites. Now verified in at least 34 states. Widespread in lower and middle Mississippi Valley; generally restricted to vicinity of stocking sites elsewhere. Tolerant of wide variations in environmental conditions — water temperatures of 0 - 35°C; salinities as high as 10 ppt; and oxygen concentrations as low as .0005 ppt. Not known to be established at most sites of stocking.

ADULT SIZE: 75 - 125 cm.

BIOLOGY: Life history and general ecology of native and introduced populations well documented, some aspects studied as early as 1700. Comprehensive reviews compiled by Provine (1975. Tex. Parks Wildl. Dept., Inland Fish Res. Spec. Rept.:1-51), Bailey (1972. Ark. Fish Game Comm., Mimeo. Rept.: 1-59), Greenfield (1973. Trans. Ill. State Acad. Sci. 66:47-53), Nair (1968. FAO Fish. Cir. No. 302:1-15), Sutton and Blackburn (1971. Ft. Lauderdale Agri. Res. Stn., Mimeo. Rept.:1-79), and Beach et al. (1976. Fla. Dept. Nat. Resour., Mimeo. Rept.:1-246). More recently, a special session on grass carp in the United States was published (Guillory and Gasaway 1978 Trans. Am. Fish. Soc. 107:104-224).

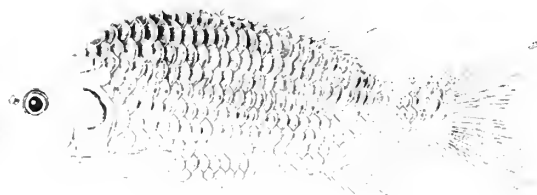
Compiler: V. Guillory. September 1978.

Cyprinus carpio Linnaeus
Common carp

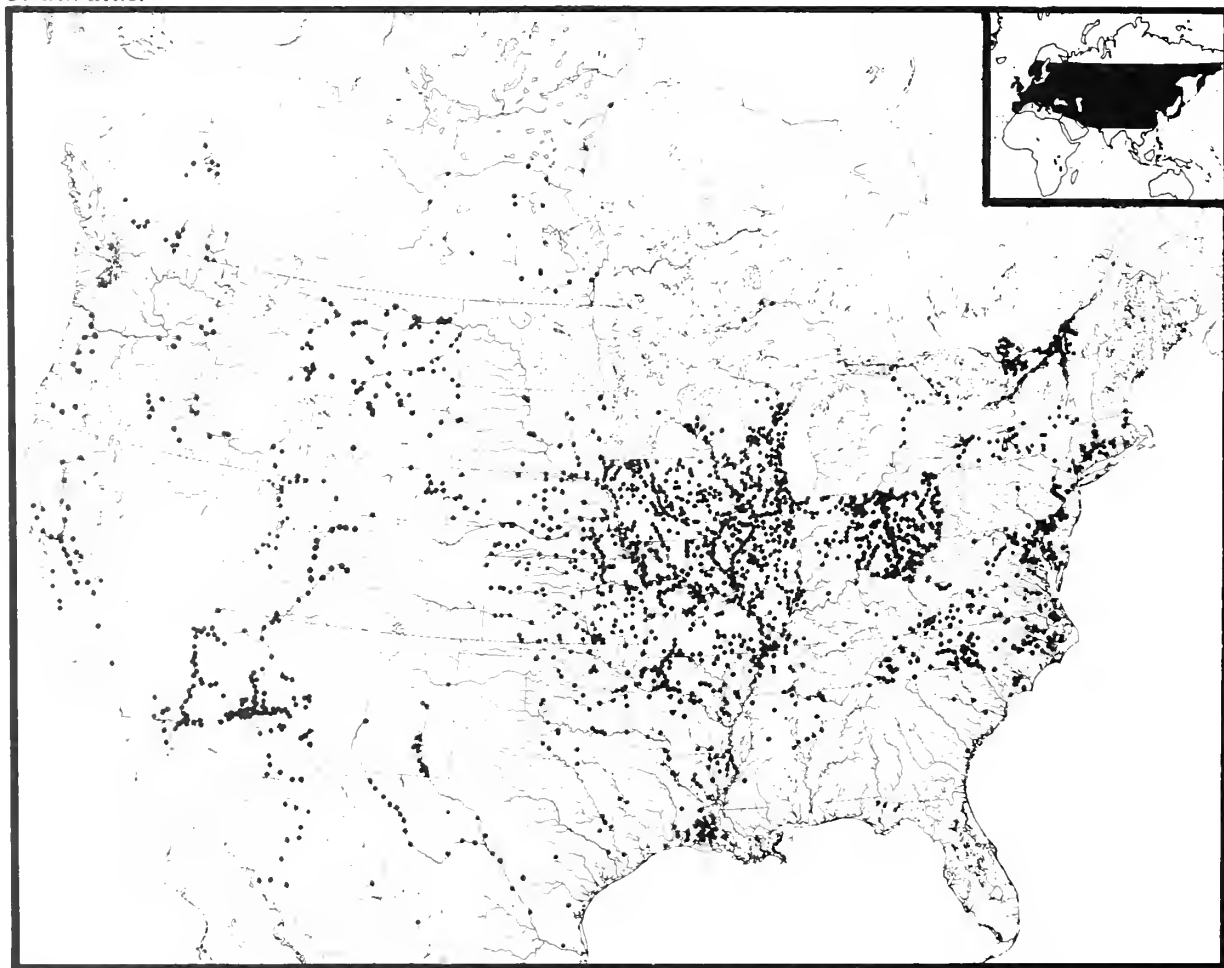
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Europe (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae 10th ed., 1:1-824).

SYSTEMATICS: Subfamily Cyprininae, which does not include native North American cyprinids. Hybridizes with goldfish, *Carassius auratus*, another exotic cyprinine (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Hubbs (in Blair [ed.] 1961. *Vertebrate Speciation: A Symposium*.) discussed Asiatic genus *Carassiops*, possibly of ancient hybrid origin between *C. carpio* and *C. auratus*.



MD: Charles Co., Community Lake, 151 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Native to temperate portions of Eurasia. Introduced into United States in 1877. Widely distributed in North America below 50th parallel. South to panhandle of FL, west through Mississippi River basin, becoming less common in west. McCrimmon (1968. Fish. Res. Can. Bull. 165: 1-93) gave detailed accounts of introduction and distribution in Canada. Often abundant in streams, natural lakes, and man-made impoundments. Occurs over all types of bottom and in clear or turbid waters.

ADULT SIZE: 216-1220 mm TL.

BIOLOGY: Scott and Crossman (1973) discussed spawning, growth rates, life expectancy, food items, and predators. Parasites studied by Bangham (1955. Am. Midl. Nat. 53:184-94). Survey of North American literature provided by Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1). Generally regarded as pest fish in North America because of habit of stirring up bottom during feeding, with consequent siltation and turbidity.

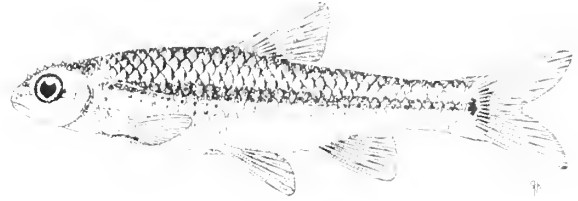
Compiler: A. W. Allen. March 1979.

***Dionda diaboli* Hubbs and Brown**
Devils River minnow

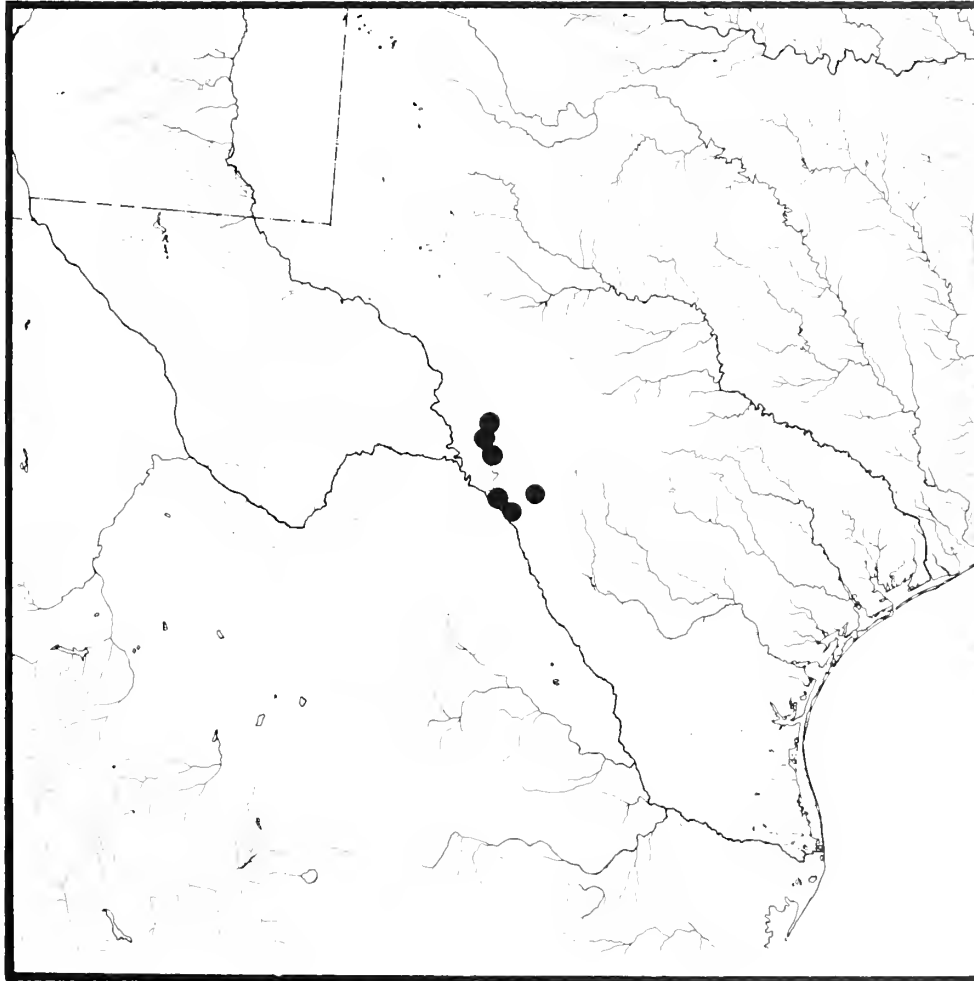
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Devils River at Baker's Crossing, Lat. 29° 57' N., Long. 101° 09' W., Val Verde Co., TX (Hubbs and Brown 1956. Southwest. Nat. 1:69-77).

SYSTEMATICS: Related and similar to *D. rasconis* from Rascon, San Luis Potosi, Mexico, and *D. episcopa*, particularly those populations in the headwaters of the Nueces River, TX.



TX: Val Verde Co., 38 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Only from free-flowing portion of Devils River, San Felipe and Sycamore creeks, Val Verde Co., and Las Moras Creek, Kinney Co., TX. Most abundant in fast flowing, clear water over gravel, and commonly syntopic with *D. episcopa*. In terms of biomass, ranks as sixth most dominant minnow in Devils River.

ADULT SIZE: 25-53 mm SL.

BIOLOGY: Channel inhabitant under normal flow regimes, and shallow riffle inhabitant after flooding (Harrell 1978. Copeia:60-68).

Compiler: H. L. Harrell. May 1978.

***Dionda episcopa* Girard**
Roundnose minnow

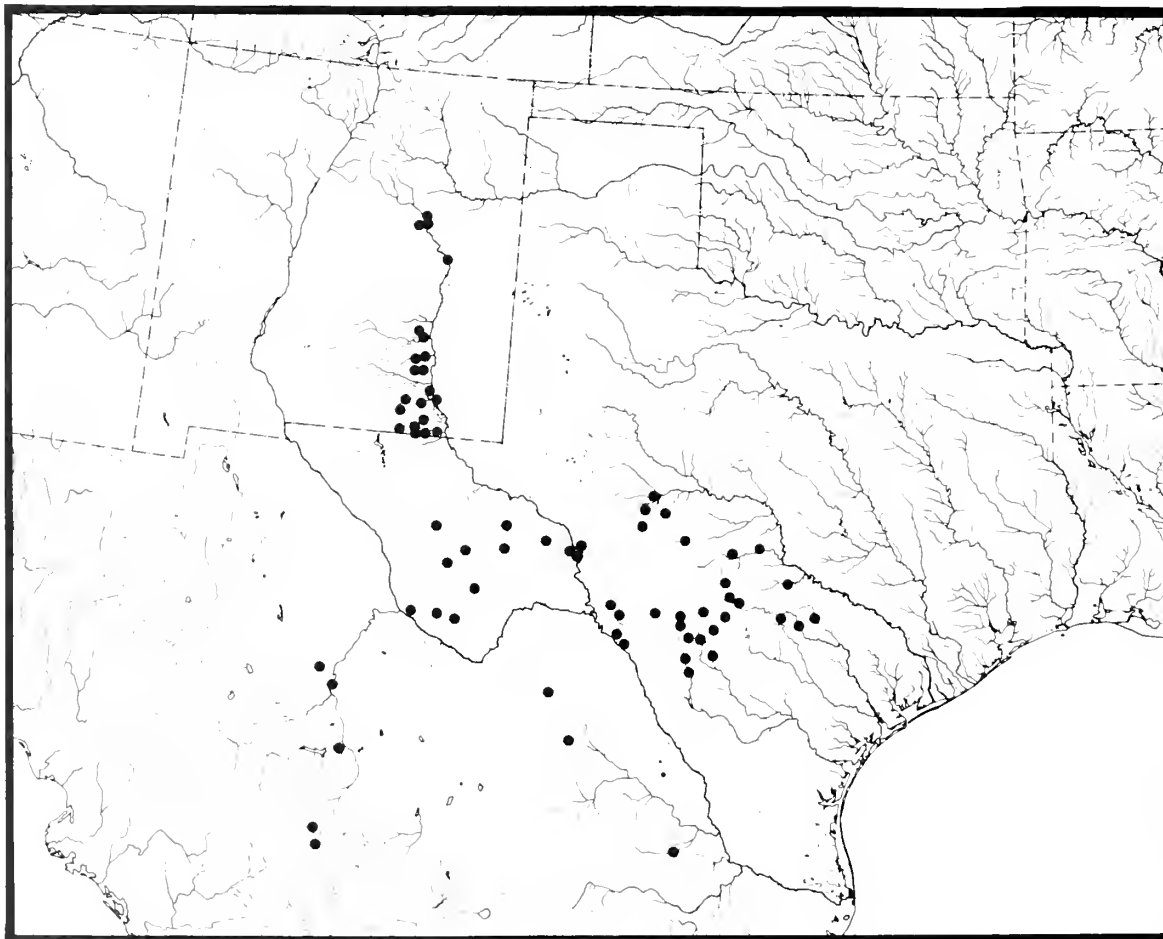
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Headwaters of Pecos River and Camanche [sic] Spring (trib. to Rio Grande), TX (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856]8:165-213).

SYSTEMATICS: Knapp (1953. *Fishes Found in the Freshwaters of Texas*) listed three subspecies from TX: *D. e. serena* from Guadalupe River west and south to Rio Grande; *D. e. episcopa* from Pecos River system of TX and NM including Big Bend region; and *D. e. couchi* in lower tributaries of Rio Grande (Girard 1857). Systematics not yet studied in detail; thus validity of subspecies yet to be clearly established.



TX: Val Verde Co., Devils River, 52 mm SL (NCSM).



DISTRIBUTION AND HABITAT: West-central TX (Colorado, San Antonio, Nueces, and Rio Grande drainages), middle to lower elevations of Pecos Valley in NM and northern Mexico. Often abundant in shallow, vegetated pools of clear, low gradient rivers and creeks. Extirpated from all but five localities in NM because of habitat alterations (New Mexico Dept. Game and Fish 1978. *Handbook of Species Endangered in New Mexico*).

ADULT SIZE: 45-64 mm SL.

BIOLOGY: Little studied. Feeds mostly on vegetation. Hubbs (1951. *Tex. J. Sci.* 3:490-92) observed breeding in seep springs, Nueces River, TX, on 15 April 1951. Mass spawning occurred in about 25 mm of water (17-18°C). Eggs heavy but nonadhesive, lodging in gravel of spring.

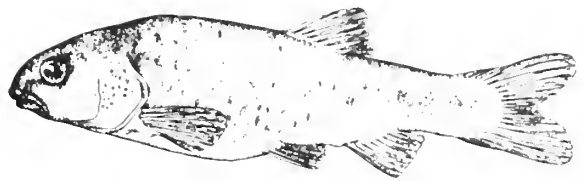
Compilers: D. S. Lee and C. R. Gilbert.
February 1979.

Eremichthys acros Hubbs and Miller
Desert dace

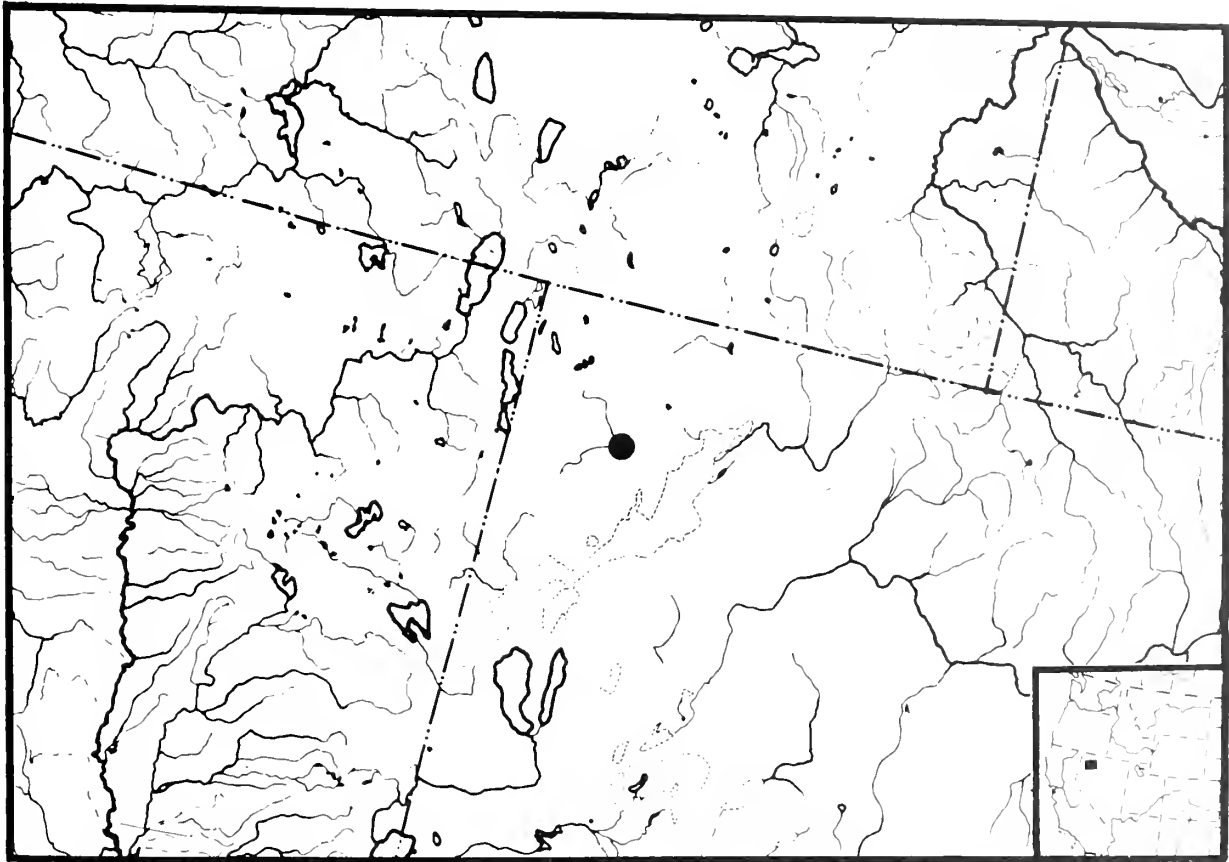
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Spring-fed ditch near northern edge of Soldier Meadows, Humboldt Co., NV (Hubbs and Miller 1948. Occas. Pap. Mus. Zool. Univ. Mich. 507:1-30).

SYSTEMATICS: Monotypic genus closely allied to *Rhinichthys* (Hubbs and Miller 1948).



NV: Humboldt Co., Soldier Meadows (LaRivers 1962).



DISTRIBUTION AND HABITAT: Restricted to warm springs and creeks of Soldier Meadows, an elevated basin (1524 m) in mountains of western Humboldt Co., NV. Abundant in its extremely localized desert habitat.

BIOLOGY: Little information available. Hubbs and Miller (1948) observed individuals in one spring where temperature was 38°C. LaRivers (1962. *Fishes and Fisheries of Nevada*) reported that diet of large specimens includes small fish. Long coiled intestine and nature of mouth, however, suggest that it feeds principally on vegetation.

ADULT SIZE: 41-60 mm SL.

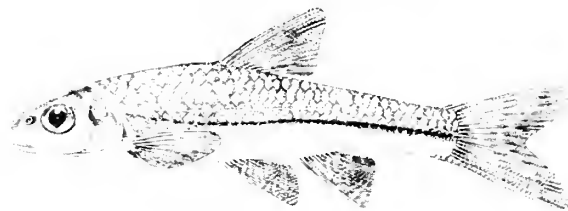
Compiler: S. P. Platania, June 1978.

Ericymba buccata Cope
Silverjaw minnow

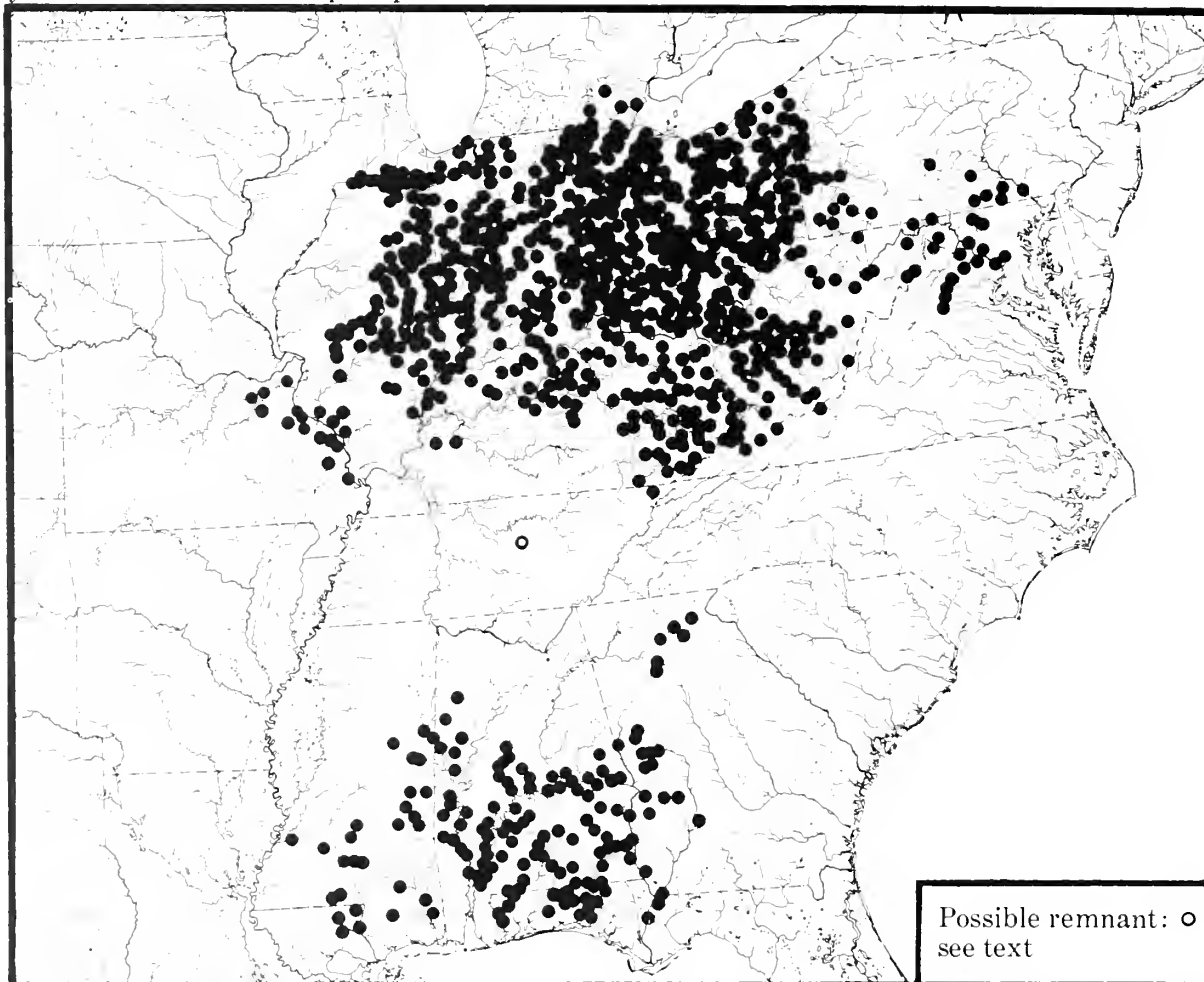
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Kiskiminetas River (tributary to Allegheny River), ca. 40 km ne of Pittsburgh, Westmoreland or Armstrong Co., PA (Cope 1865. Proc. Acad. Nat. Sci. Phila. 17:87-88).

SYSTEMATICS: Monotypic genus; most closely resembles some *Notropis* species.



MD: Montgomery Co., Goshen Branch, 69 mm SL (NCSM).



Possible remnant: ○
see text

DISTRIBUTION AND HABITAT: An unusual disjunct distribution. Ranges from southeastern MI south to Gulf slope drainages from MS to FL, but is absent from most of Cumberland River below Cumberland Falls, and Tennessee River. Record from upper Tennessee drainage in TN may represent remnant of a population that reached there via stream capture from upper Cumberland drainage. On Gulf slope, ranges from Apalachicola drainage in FL and GA, west to Pearl River drainage in LA and MS. To north ranges from eastern MO east to WV and western PA. Has also entered Potomac River drainage on Atlantic slope, and has subsequently crossed over into lower Susquehanna and upper Rappahannock river drainages. One 1890's record from northwestern AR is presumed to be result of transposed

locality data and is not shown on the map. In medium to large, flowing streams, where it is closely restricted to a shifting sand substrate. Often common.

ADULT SIZE: 30-45 mm SL, 56 mm SL maximum.

BIOLOGY: Definitive studies by Wallace (1971. Am. Midl. Nat. 86:116-27; 1972. Am. Midl. Nat. 87:172-90; 1973. Trans. Am. Fish. Soc. 102:786-93) on age and growth, reproduction, and general ecology. Hoyt (1971. Trans. Am. Fish. Soc. 100:510-19; 1970. Am. Midl. Nat. 84:226-36; 1971. Am. Midl. Nat. 86:257-75) also studied many aspects of biology.

Compiler: C. R. Gilbert. February 1978.

Eroglossum laurae (Hubbs)
Tonguetied minnow

Order Cypriniformes
Family Cyprinidae

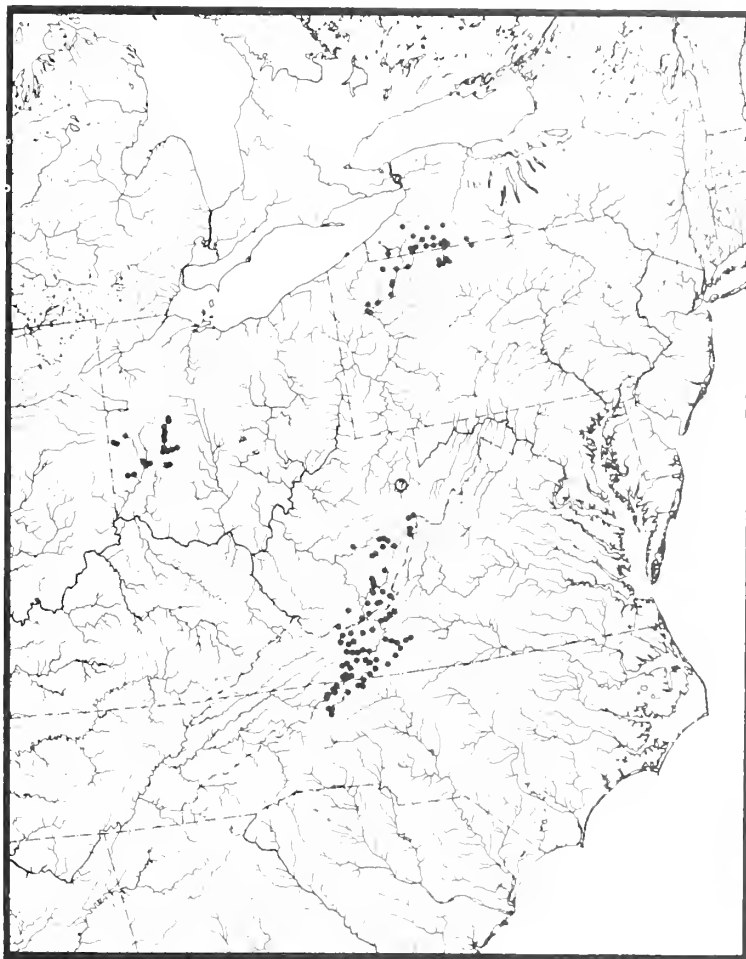
TYPE LOCALITY: Second Creek, tributary of Greenbrier River, s of Ronceverte, WV (Hubbs 1931. Occas. Pap. Mus. Zool. Univ. Mich. 234:1-12).

SYSTEMATICS: Genus *Pareroglossum*, erected for *E. laurae*, combined with formerly monotypic genus *Eroglossum* by Bailey et al. (1970. Am. Fish. Soc. Spec. Pub. 6: 1-150), Jenkins and Lachner (1971. Smithson. Contrib. Zool. 90:1-15), and Gilbert and Bailey (1972. Occas. Pap. Mus. Zool. Univ. Mich. 664:1-35). *Pareroglossum* recognizable as subgenus and primitive relative to subgenus *Eroglossum*. *Eroglossum* once thought to merit subfamily status, but was not so recognized by Hubbs (1931). Genus probably related to other mound nest building cyprinids such as *Semotilus* and *Nocomis* (Jenkins 1971. ASB Bull. 18:40). Form in OH, *hubbsi*, downgraded to subspecies of *laurae* by Trautman (1957. *The Fishes of Ohio*), who noted that it may not be even subspecifically distinct. No significant difference found between Kings Creek, OH, and Greenbrier system, New drainage, WV, populations in blood electrophoretic study (M. Pressick unpubl.). Hybridizes naturally with *E. marillina* in Walker Creek system of New drainage, VA.

DISTRIBUTION AND HABITAT: Upper and middle Ohio River basin, with three disjunct population groups: New (upper Kanawha) drainage, NC, VA, WV; upper Great Miami River and upper Little Miami River systems, southwest OH; middle and upper Allegheny drainage, PA, NY. Range of OH population probably now limited to only Kings Creek and Mad River near Kings Creek mouth (Smith et al. 1973. Ohio J. Sci. 73:257-71). One record in 1951 from upper Monongahela drainage (Ohio basin), WV (Cornell Univ. 32639), where species possibly is extirpated; exact locality unknown, indicated by ? on map. Also occupies upper Genesee system of Lake Ontario drainage, southwest NY, above falls at Portageville (Raney 1941. Copeia:272). Inhabits cool to warm, usually clear, small to large streams of moderate gradient, generally with relatively unsilted bottoms of gravel, rubble and boulder. Typically in pools and runs.



NY: Cattaraugus Co.,
Allegheny River, 76 mm SL
(NCSM).



ADULT SIZE: 65-135 mm SL.

BIOLOGY: Single male constructs pebble mound nest without preceding excavation. Nest guarding observed 15 June, water 21°C, in PA (Raney 1939. Copeia:112-13) and spawning on 20 June, 20°C, in VA. Life history study of OH population by Taub found spawning in May, water ca. 14-18°C. Rebuilds nests destroyed by flood. Fecundity ca. 1800 ova per female. Oldest adult age group IV.

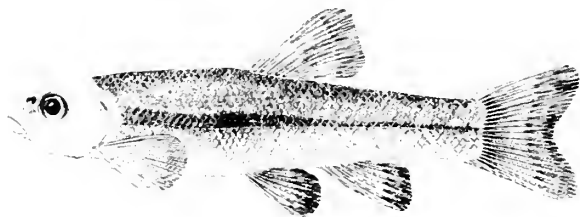
Compilers: R. E. Jenkins, C. R. Gilbert, and S. H. Taub. June 1979.

Exoglossum maxillingua (Lesueur)
Cutlips minnow

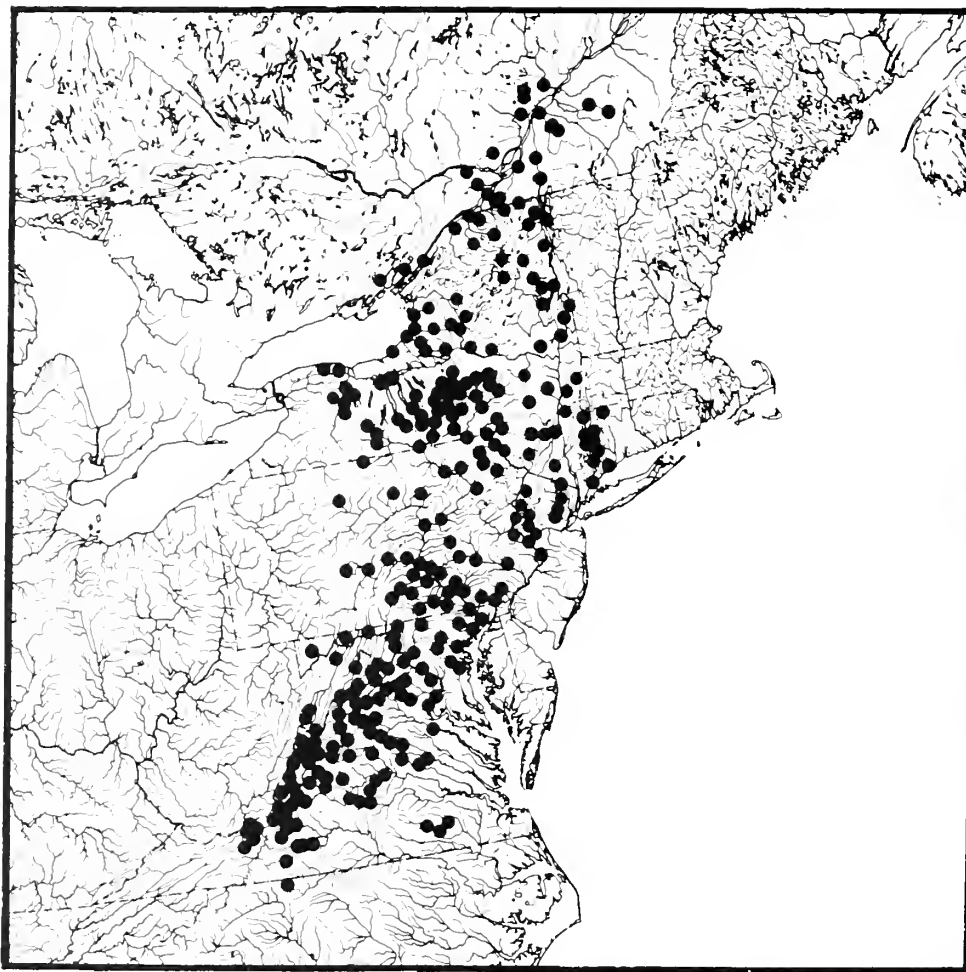
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Pipe Creek, Carroll Co., MD (Lesueur 1817. J. Acad. Nat. Sci. Phila. 1:85-86).

SYSTEMATICS: Apparently evolved from common ancestor of more primitive *E. laurae* (Hubbs 1931. Occas. Pap. Mus. Zool. Univ. Mich. 234:1-12). Genus apparently most closely related to other nest building cyprinids of genera *Semotilus* and *Nocomis* (Jenkins 1971. ASB Bull. 18:40).



MD: Baltimore Co., Deer Creek (NCSM).



DISTRIBUTION AND HABITAT: Northeastern North America, from St. Lawrence River and eastern Lake Ontario drainages south on Atlantic slope to upper Roanoke River drainage, NC, and in small section of New River drainage, VA and WV. In clear, gravel, rubble, and boulder streams largely free of silt and sand and with limited amounts of rooted plants. Fairly common, bottom-dwelling minnow usually found under rocks in quiet pools and runs.

ADULT SIZE: 95-120 mm SL.

BIOLOGY: More study has been devoted to this species' ecology than is true of most minnows. Haase and Haase (1975. Proc. Pa.

Acad. Sci. 49:67-72) summarized previous work in their study of feeding ecology. Hankinson (1922. Copeia:1-3) described construction of pebble nest. Van Duzer (1939. Copeia:65-75) discussed location and size of nests, nest building activities, spawning behavior, and activity of fry in NY. First spawning in late May and continues at water temperatures from 17-22°C. Feeds mostly on mollusks and bottom-dwelling insects (trichopterans and dipterans) and less on algae, detritus, and mayflies (Haase and Haase 1975). Most individuals live two years.

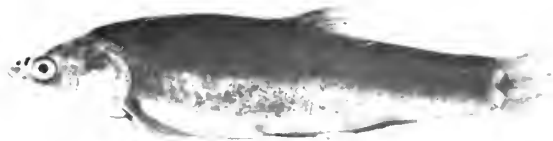
Compilers: C. R. Gilbert and D. S. Lee. September 1978.

***Gila alvordensis* Hubbs and Miller**
Alvord chub

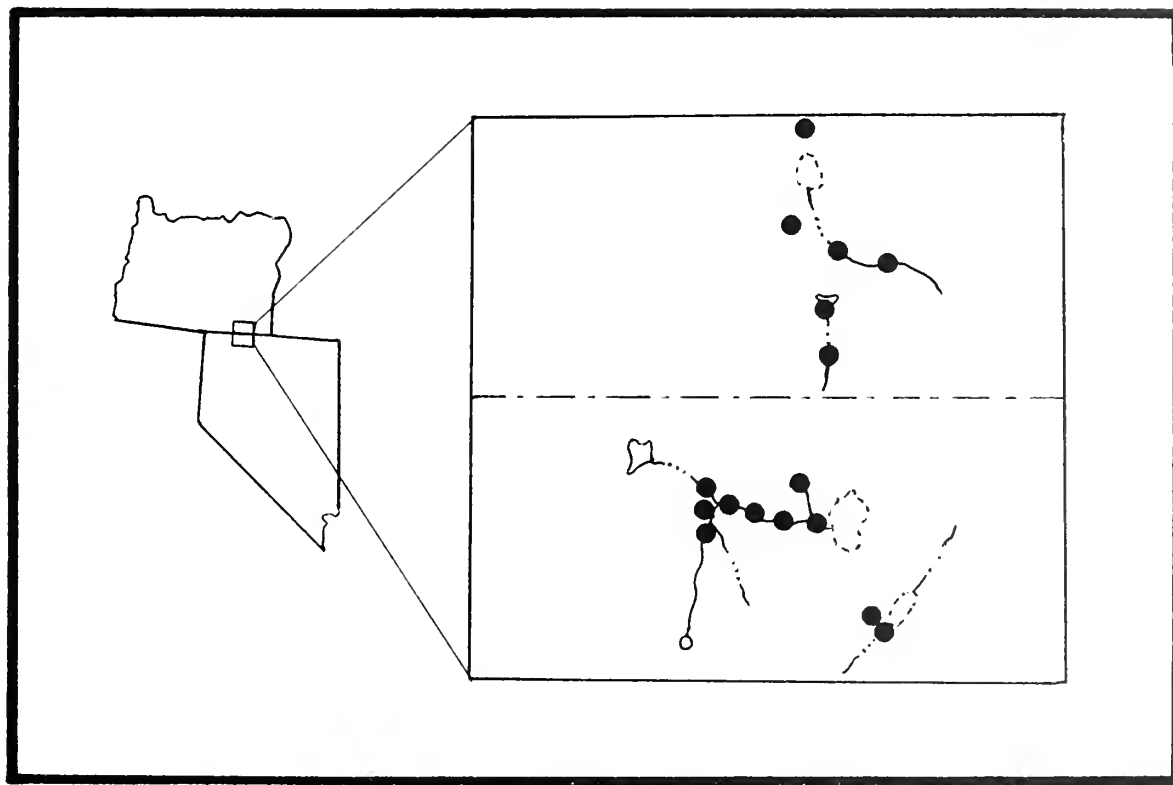
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Trout Creek, tributary to Alvord Desert, just below canyon and bridge where roads to Denio, Jordan Valley, and Fields meet, T39S, R36E, Harney Co., OR (Hubbs and Miller 1972. Trans. San Diego Nat. Hist. 17:101-06).

SYSTEMATICS: Moderate-sized chub with much reduced and embedded scales whose characters agree most closely with those species of *Gila* formerly placed in genus *Siphateles*. Dwarf form, currently referred to *G. alvordensis*, in Borax Lake is proposed as a distinct species (Williams and Bond, ms).



OR: Harney Co., Trout Creek,
82 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to Alvord basin of southeastern OR and northwestern NV, particularly Trout Creek drainage in OR and Virgin Creek drainage in NV. Wide variety of habitats in streams, springs, and reservoirs.

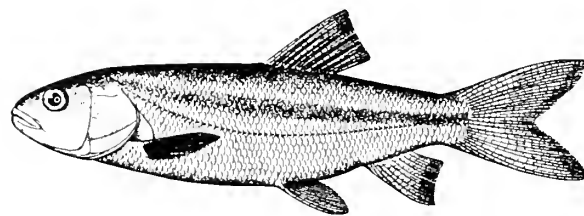
ADULT SIZE: 70-100 mm SL, ca. 120 mm SL maximum.

BIOLOGY: No studies published although work is currently underway. Observations indicate the fish to be generalistic in food and habitat requirements, as are many western endemics.

Compiler: J. E. Williams. August 1978.

Gila atraria (Girard)
Utah chub

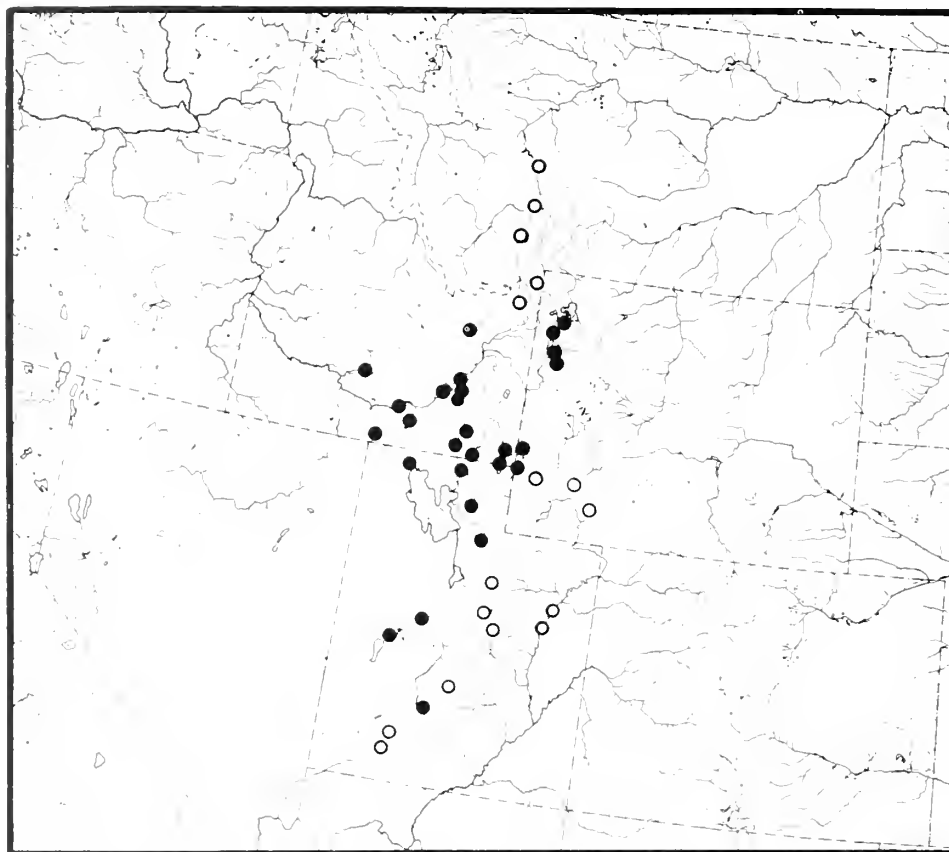
Order Cypriniformes
Family Cyprinidae



WY: Yellowstone Park (Jordan
and Evermann 1900)

TYPE LOCALITY: Fish Springs, Tooele Co., UT. (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Subgenus *Gila*. Originally described as *Siboma atraria*. Considerable confusion has existed and list of synonyms is long. LaRivers (1962. *Fishes and Fisheries of Nevada*) summarized taxonomic history. Miller (1945. Copeia:104-10) and Uyeno (1960. Ph.D. diss., Univ. Michigan) helped clarify relationships of this species and others in genus *Gila*.



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Native range is waters of ancient Lake Bonneville basin in UT, ID, WY, and NV (Sigler and Miller 1963. *Fishes of Utah*). Also native in Snake River drainage above Shoshone Falls. Accidentally introduced into number of river systems outside native range, including Colorado in UT (Sigler and Miller 1963), Green in WY (Baxter and Simon 1970. *Wyoming Fishes*), and upper Missouri in MT (Brown 1971. *Fishes of Montana*). Recently reported near Boise, ID, in Snake River drainage below Shoshone Falls. A fish of both lakes and rivers, often associated with dense vegetation. Adaptable to wide range of temperatures.

ADULT SIZE: 130-220 mm SL.

BIOLOGY: Age, growth, and food habits studied in UT by Neuhold (1955. Trans. Am. Fish. Soc. 85:217-33), in WY by John (1959. Ecology 40:564-71), and in MT by Graham (1961. Trans. Am. Fish. Soc. 90: 269-76). Generalized omnivore, feeding mainly on vegetation and invertebrates. Considered nuisance species by most management agencies. Attempts to control populations usually unsuccessful. It is important to note that those waters in which species has become a nuisance either are not within native range or, if so, have been much modified by man (Sigler and Miller 1963).

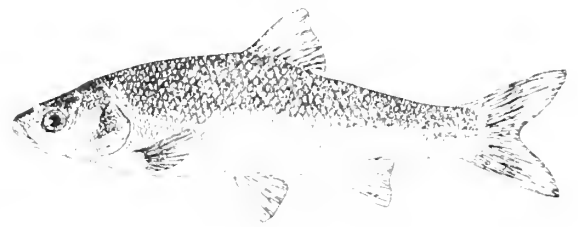
Compiler: R. L. Wallace, June 1978.

Gila bicolor (Girard)
Tui chub

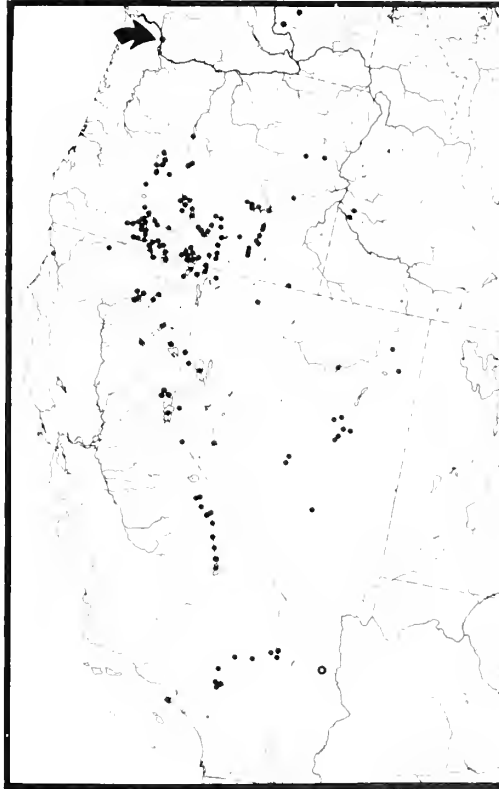
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Klamath Lakes, Klamath Co., OR (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Geographic isolation led to formation of at least 13 subspecies, but relationships unclear (LaRivers 1962. *Fishes and Fisheries of Nevada*; Moyle 1976. *Inland Fishes of California*; Deacon et al. 1979. Fisheries 4:30-44). Much confusion has surrounded nomenclature (LaRivers 1962), but Bailey and Uyeno (1964. Copeia:238-39) resolved much of problem.



CA: Siskiyou Co., Scott River,
18 cm SL (Moyle 1976).



Open circle transplanted population

DISTRIBUTION AND HABITAT: Widely distributed in Klamath, Lahontan, and Columbia river systems, and Harney and Catlow basins. Early records from Kalama, Crab Creek, and Moses Lake, Grant Co., WA, as well as Portland fish market. Also in Upper Pit River and Goose Lake of Sacramento-San Joaquin system and in Owens and Mohave river systems. Introduced into a few areas including reservoirs of Sacramento River drainage, a small pond in South Coast Botanic Garden (St. Amant and Sasaki 1971. Calif. Fish Game 57: 307-08), and Colorado River drainage at Fort Piute, San Bernadino Co., CA (Swift, pers. comm.). Schools in weedy shallows of lakes or quiet waters of slow-moving rivers.

ADULT SIZE: Maximum size 305-356 mm.

BIOLOGY: Opportunistic omnivore concentrating on invertebrates associated with the substrate. Spawns primarily from late April through late June (Moyle 1976). Kimsey (1954. Calif. Fish Game 40:395-410) discussed life history in Eagle Lake, CA. Harry (1951. Calif. Fish Game 37:129-32) illustrated embryonic and early larval stages. Most subspecies considered endangered or threatened (St. Amant and Sasaki 1971; Moyle 1976; Deacon et al. 1979).

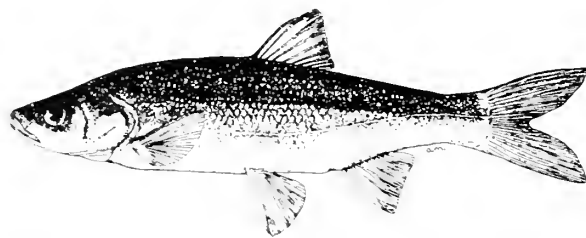
Compiler: R. E. Smith, Jr. September 1979.

Gila coerulea (Girard)
Blue chub

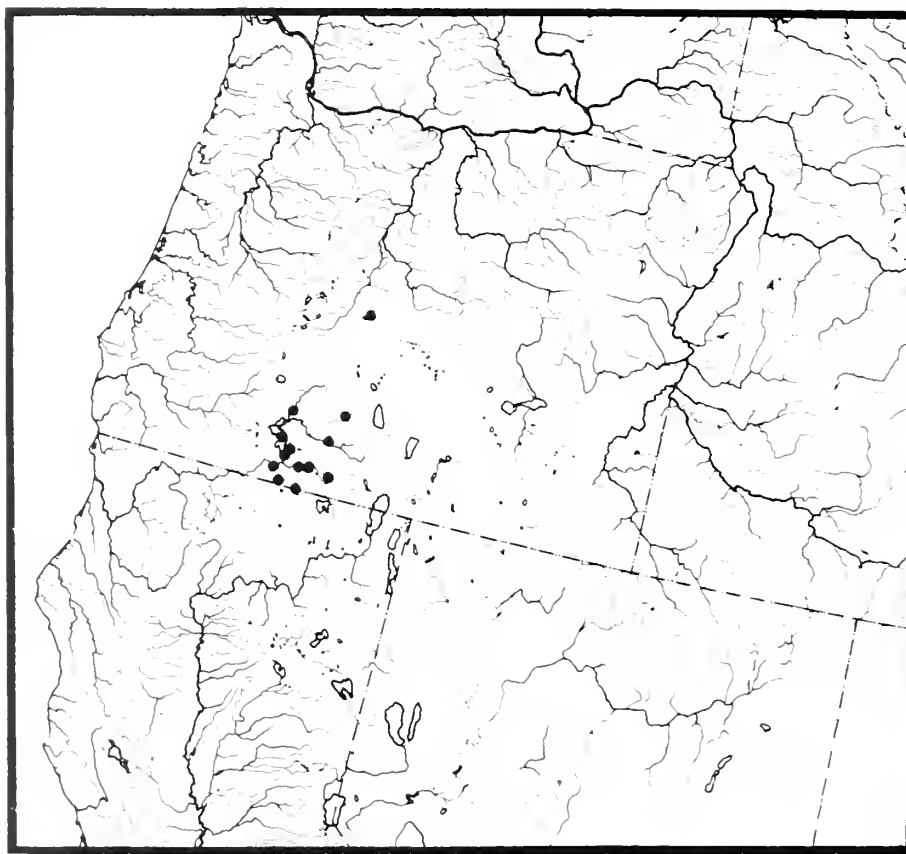
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Klamath Lake, O.T. (Oregon Territory) and Lost River, O.T. (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Girard (1857) described this species twice in same publication, as *Tigoma bicolor* (Klamath Lake) and as *Cheonda coerulea* (Lost River). These nomenclature problems clarified by Bailey and Uyeno (1964. Copeia:238-39). Prior to this the species had been referred to as *G. bicolor*, but these workers refer the tui chub to *G. bicolor* and the blue chub to *G. coerulea*.



CA: Siskiyou Co., Tule Lake,
15 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Widely distributed in Klamath and Lost River systems, OR and CA; introduced elsewhere (not shown on map). Very abundant in Upper Klamath Lake and apparently in other reservoirs (Moyle 1976. *Inland Fishes of California*). Study in Upper Klamath Lake suggests species is widespread in lake, but avoids marshy shore areas (Vincent 1968. M.S. thesis, Oregon State Univ.). This study found them in areas with dissolved oxygen as low as 0.1 ppm.

ADULT SIZE: 100-340 mm TL.

BIOLOGY: Habitat data in Vincent (1968). Bird (1975. M.S. thesis, Oregon State Univ.) studied life history of introduced Paulina Lake population, OR. Sexual maturity reached in fourth summer, and spawning occurred in July-August adjacent to shore over clean gravel or large rock substrate. Spawning in Upper Klamath Lake observed May-June over shallow rocky substrate (Moyle 1976). Aquatic insect larvae, cladocerans, and filamentous algae are major foods (Bird 1975.).

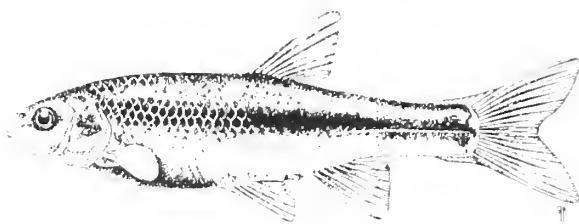
Compiler: K. M. Howe. July 1978.

Gila copei (Jordan and Gilbert)
Leatherside chub

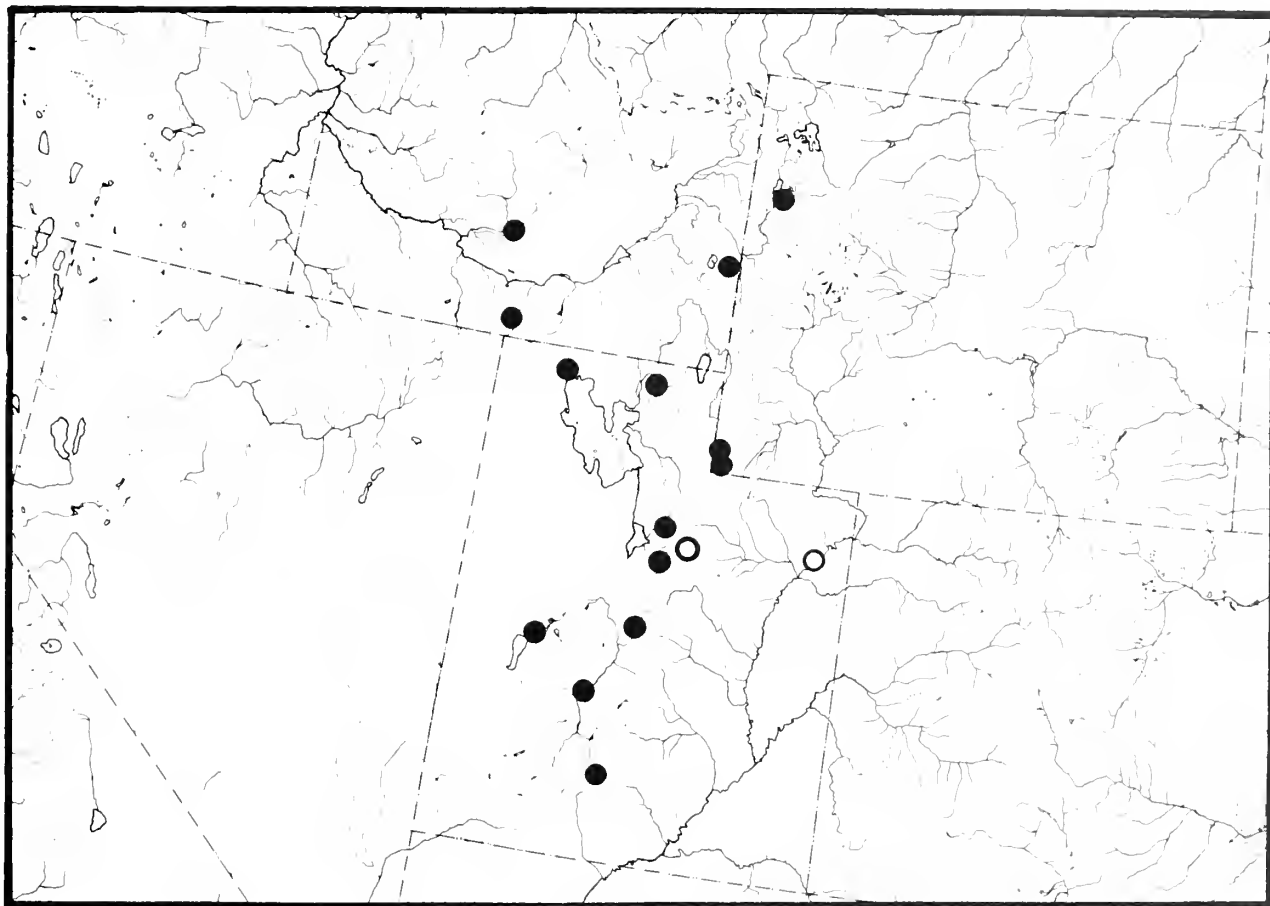
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Bear River at Evanston, Uinta Co., WY (Jordan and Gilbert 1881. Proc. U.S. Natl. Mus. [1880] 3:459-64).

SYSTEMATICS: Originally named *Squalus copei*, this species was placed in five other genera before Miller (1945. J. Wash. Acad. Sci. 35:28) erected new monotypic genus, *Snyderichthys*. Uyeno (1960. Ph.D. diss., Univ. Michigan) restudied problem and relegated it to genus *Gila*, subgenus *Snyderichthys*.



UT: Sumpete Co., Sevier River, 72 mm SL (NCSM).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Cool to cold creeks and rivers in pools or riffles in moderate current (Sigler and Miller 1963. *Fishes of Utah*), with apparent preference for pools rather than riffles (Baxter and Simon 1970. *Wyoming Fishes*). Bonneville and upper Snake River basins of UT, ID, and WY, and in Wood River drainage of ID (Simpson and Wallace in press. *Fishes of Idaho*). Sigler and Miller (1963) noted that species may have been introduced into upper Snake River since was not taken there until 1934. Established in Colorado River system by introduction (Sigler and Miller 1963).

ADULT SIZE: 60-110 mm SL.

BIOLOGY: Little known. Probably spawns in summer, based on presence of brightly colored males and females distended with eggs (Sigler and Miller 1963).

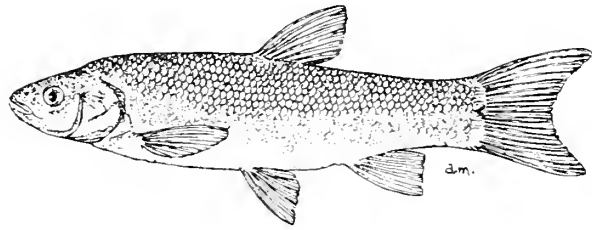
Compiler: R. L. Wallace, June 1978.

Gila crassicauda (Baird and Girard)
Thicktail chub

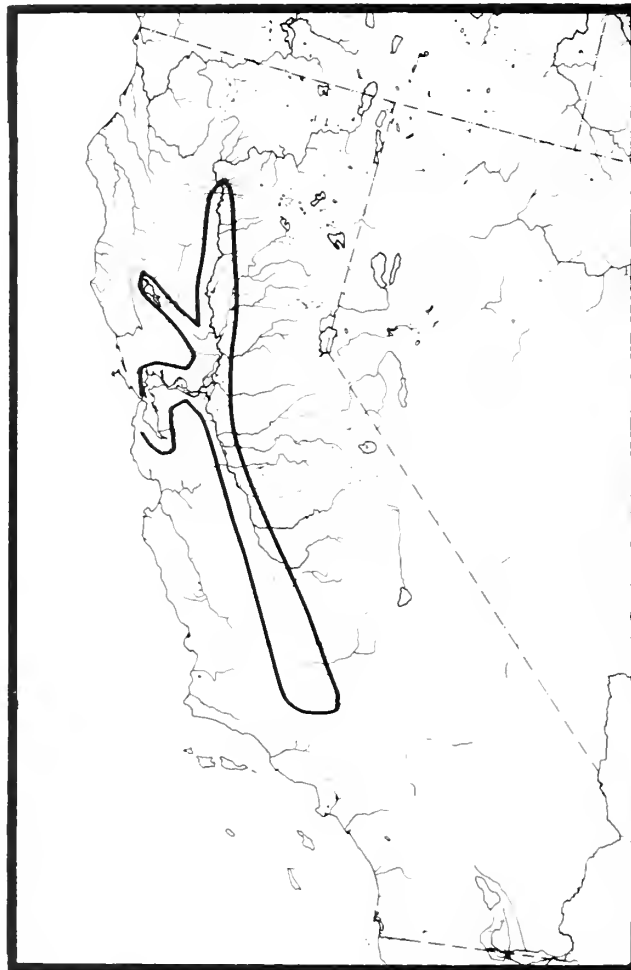
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: San Joaquin River, CA
(Girard 1854. Proc. Acad. Nat. Sci. Phila.
[1854-55] 7:129-40).

SYSTEMATICS: Subgenus *Gila* (Uyeno
1961. Ph.D. diss., Univ. Michigan). System-
atics and morphology reviewed by Miller
(1963. Calif. Fish Game 49:20-29).



11 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Probably
extinct, since last specimens were collected
in 1950. Formerly abundant and widespread
in lakes and sloughs of Sacramento-San Joa-
quin Valley and in Clear Lake, Lake Co., CA.
Map outlines probable former range.

ADULT SIZE: 150-250 mm SL.

BIOLOGY: Unknown.

Compiler: P. B. Moyle. July 1978.

Gila cypha Miller
Humpback chub

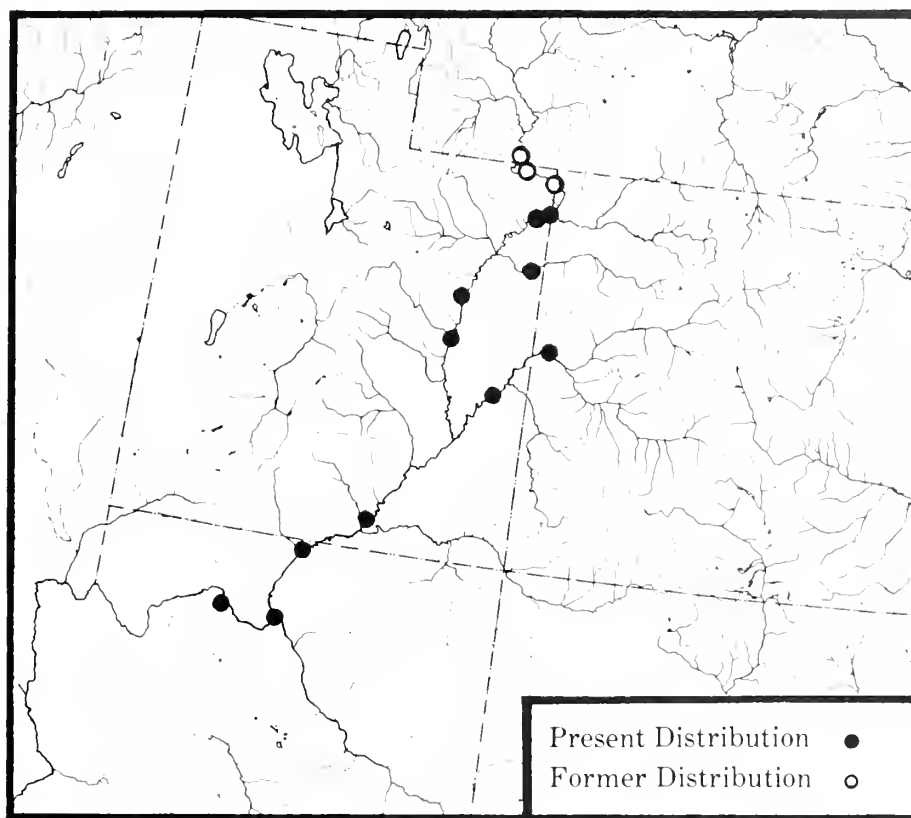
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Colorado River, Grand Canyon at mouth of Bright Angel Creek, AZ (Miller 1946. J. Wash. Acad. Sci. 36:409-15).

SYSTEMATICS: Subgenus *Gila*, Smith et al. (1979. Proc. 1st Conf. Sci. Res. Nat. Parks. 1:613-23) reviewed systematics of this and related *G. elegans* and *G. robusta*, demonstrating specific distinction of all three taxa in big river habitats of the Colorado River system. Suttkus and Clemmer (1977. Occas. Pap. Tulane Univ. Mus. Nat. Hist. 1:1-30) provided additional morphometric data for specimens from Grand Canyon.



(LaRivers 1962)



DISTRIBUTION AND HABITAT: Canyon reaches of middle and upper Colorado and Green rivers. Remains known from Indian sites along lower Colorado River. Generally uncommon, but locally concentrated, with largest extant populations in and near mouth of Little Colorado River, AZ, and in Desolation Canyon of Green River, UT.

ADULT SIZE: 200-300 mm SL, 320 mm SL maximum.

BIOLOGY: Little known. Often in deep, swift areas, but also common in canyon-shaded pools or along deep, ledge-shaded reaches with moderate current (C. O. Minckley original data).

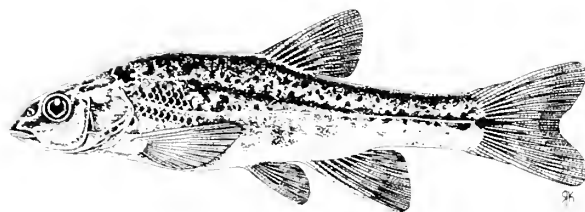
Compilers: P. B. Holden and W. L. Minckley.
March 1980.

***Gila ditaenia* Miller**
Sonora chub

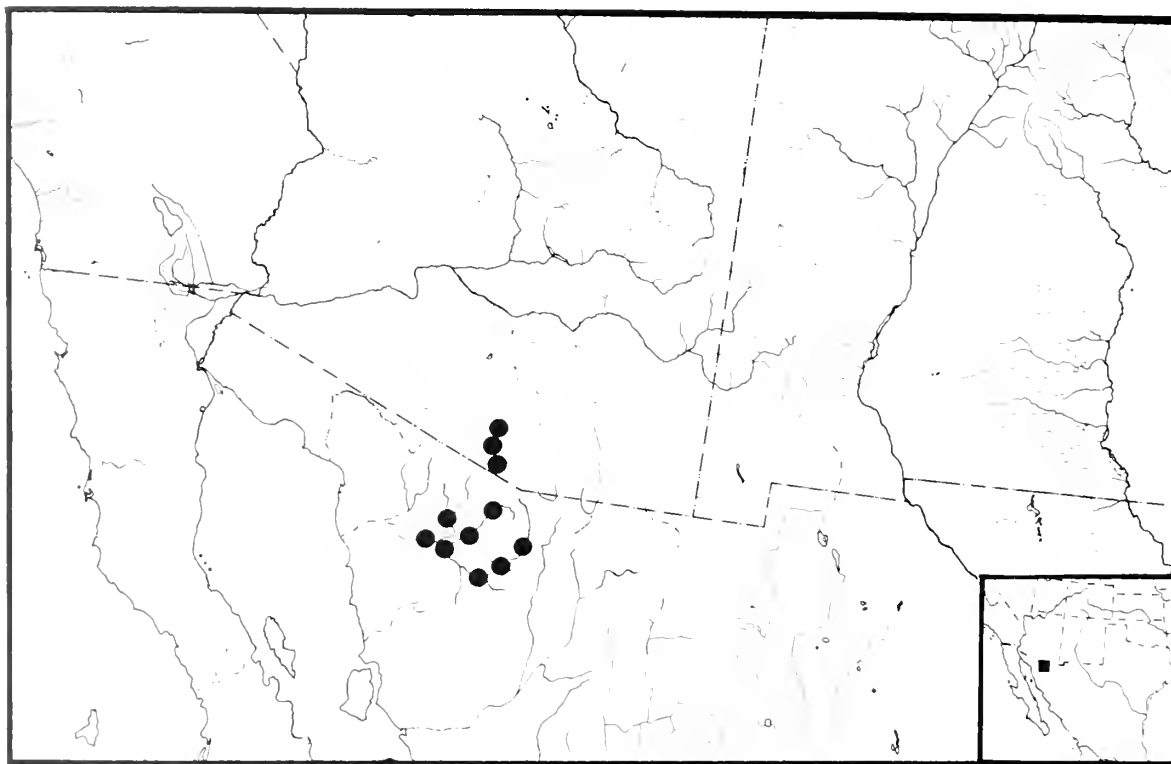
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Mexico, Sonora, Rio Magdalena, 0.5 km w of La Casita, ca. 40 km s of Nogales, AZ, 30° 58' N, 110° 52' W (Miller 1945. Copeia:104-10).

SYSTEMATICS: Subgenus *Temeculina* (Barbour and Miller 1978. Misc. Publ. Mus. Zool. Univ. Mich. 155:1-72). Miller (1945) aligned it with *G. purpurea* of Rio Yaqui and smaller associated basins to south and east, and with *G. orcutti* of Los Angeles Plain (CA) and adjacent drainages.



AZ: Santa Cruz Co., Bear Canyon, 83 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Rios Altar and Magdalena co-tributaries forming Rio de la Concepcion (= Rio Asuncion), which typically sinks into its sandy channel before reaching Gulf of California (about 260 km south of Colorado River Delta). Restricted in United States to Sycamore (= Bear) Canyon west of Nogales, Santa Cruz Co., AZ, where it inhabits pools near cliffs, boulders, or other cover in the channel, and also headsprings and seeps (Minckley 1973. *Fishes of Arizona*).

BIOLOGY: Spawns in early spring (February-April) on basis of young in collections and adults in reddened breeding coloration. Foods in early summer are aquatic and terrestrial insects, and algae. Becomes concentrated in restricted pools during seasonal drought, where predation by belostomatid hemipterans is severe. Dispersal from these pools by adults is minimal, even in periods of high flow (Minckley and Deacon 1968. Science 159: 1424-32; Minckley 1973).

ADULT SIZE: Rarely more than 75 mm.

Compiler: W. L. Minckley. July 1978.

Gila elegans Baird and Girard
Bonytail chub

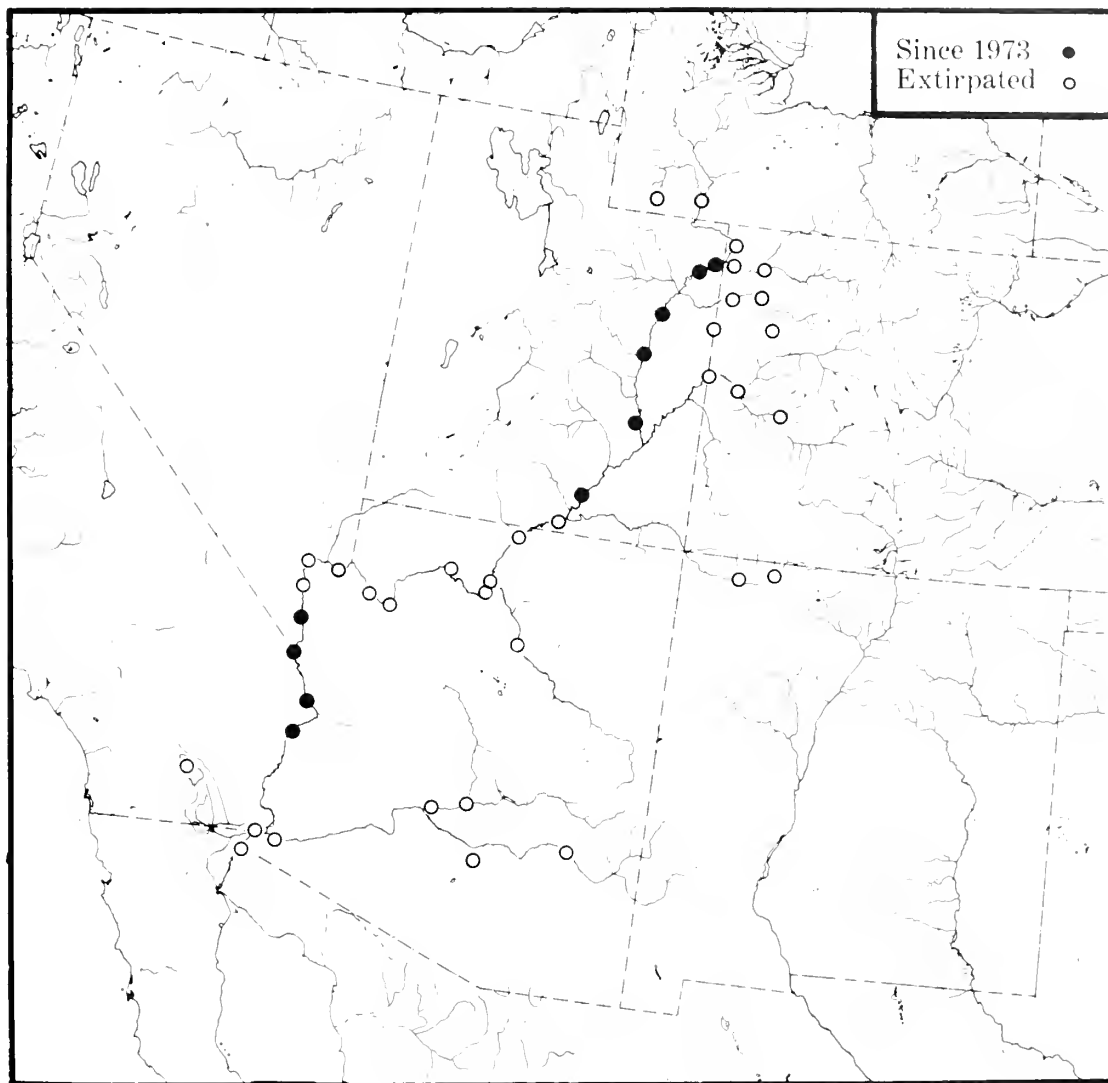
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Zuni River, NM (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. [1852-53] 6:368-69). Type locality probably in error.

SYSTEMATICS: Subgenus *Gila*. Smith et al. (1979. Proc. 1st. Conf. Sci. Res. Nat. Parks 1:613-23) reviewed systematics of this and related *G. cypha* and *G. robusta* and demonstrated specific destination of all three taxa in big-river habitats of Colorado River system.



WY: Green River, 30 cm SL
(Moyle 1976).



DISTRIBUTION AND HABITAT: Large main channels of Green, Colorado, and Gila rivers in Colorado River basin. Presently very rare, near extinction; recently taken only from Green River and Lake Mohave.

BIOLOGY: Generally associated with swift currents; feeds on surface. Vanicek and Kramer (1969. Trans. Am. Fish. Soc. 98:193-208) have some notes on life history. Observed spawning in reservoirs but no success noted (Minckley 1973. *Fishes of Arizona*).

ADULT SIZE: 52 cm SL maximum.

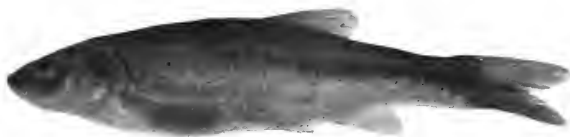
Compiler: P. B. Holden. April 1980.

Gila nigrescens (Girard)
Chihuahua chub

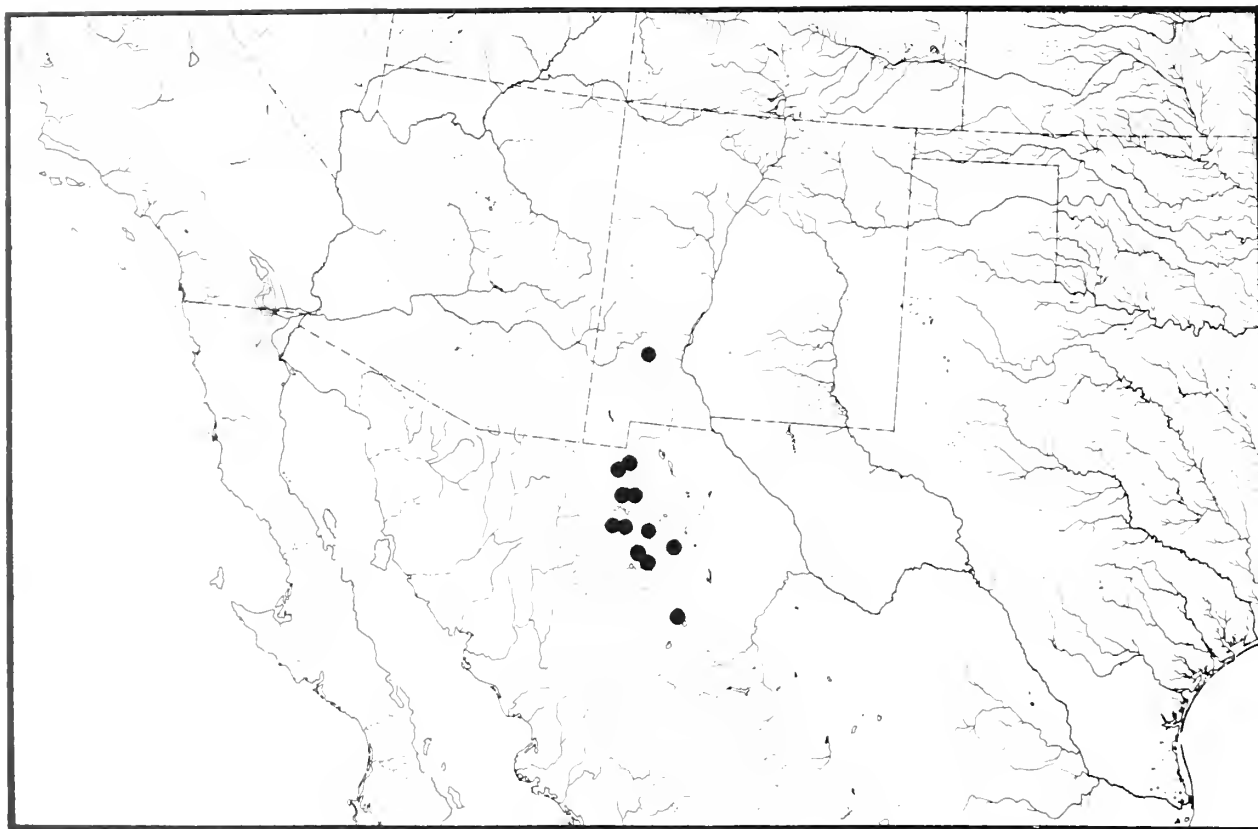
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Boca Grande and Rio Janos, vicinity of Janos, 30° 53' N, 108° 11' W, Chihuahua, Mexico (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Subgenus *Gila* (Uyeno 1961. Ph.D. diss., Univ. Michigan); presumably most closely related to *G. pandora* of Rio Grande basin.



Mexico: Rio Piedras Verdes at Colonia, Juarez, 89 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Restricted to tributaries of endorheic Laguna Guzman basin of northern Chihuahua, Mexico (Mimbres River, NM, and rios Casas Grandes, Santa Maria, and del Carmen, Chihuahua), and basin of Laguna Bustillos, Chihuahua (Miller 1978. Nat. Park Serv. Trans. Proc. Ser. 3:365-81). Most often in pools of small to moderate-sized streams, typically in association with cover such as debris, boulders, or cut banks.

ADULT SIZE: ca. 200 mm maximum.

BIOLOGY: Essentially unknown. Spawns late April to May in Mimbres River, NM. For years thought to be extinct in United States (Koster 1957. *Guide to the Fishes of New Mexico*), but recently rediscovered.

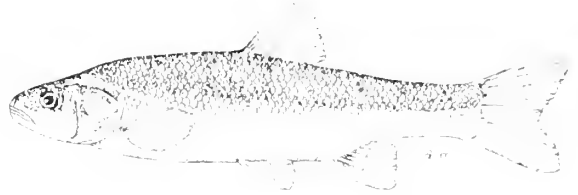
Compiler: W. L. Minckley. July 1979.

***Gila orcutti* (Eigenmann and
Eigenmann)**
Arroyo chub

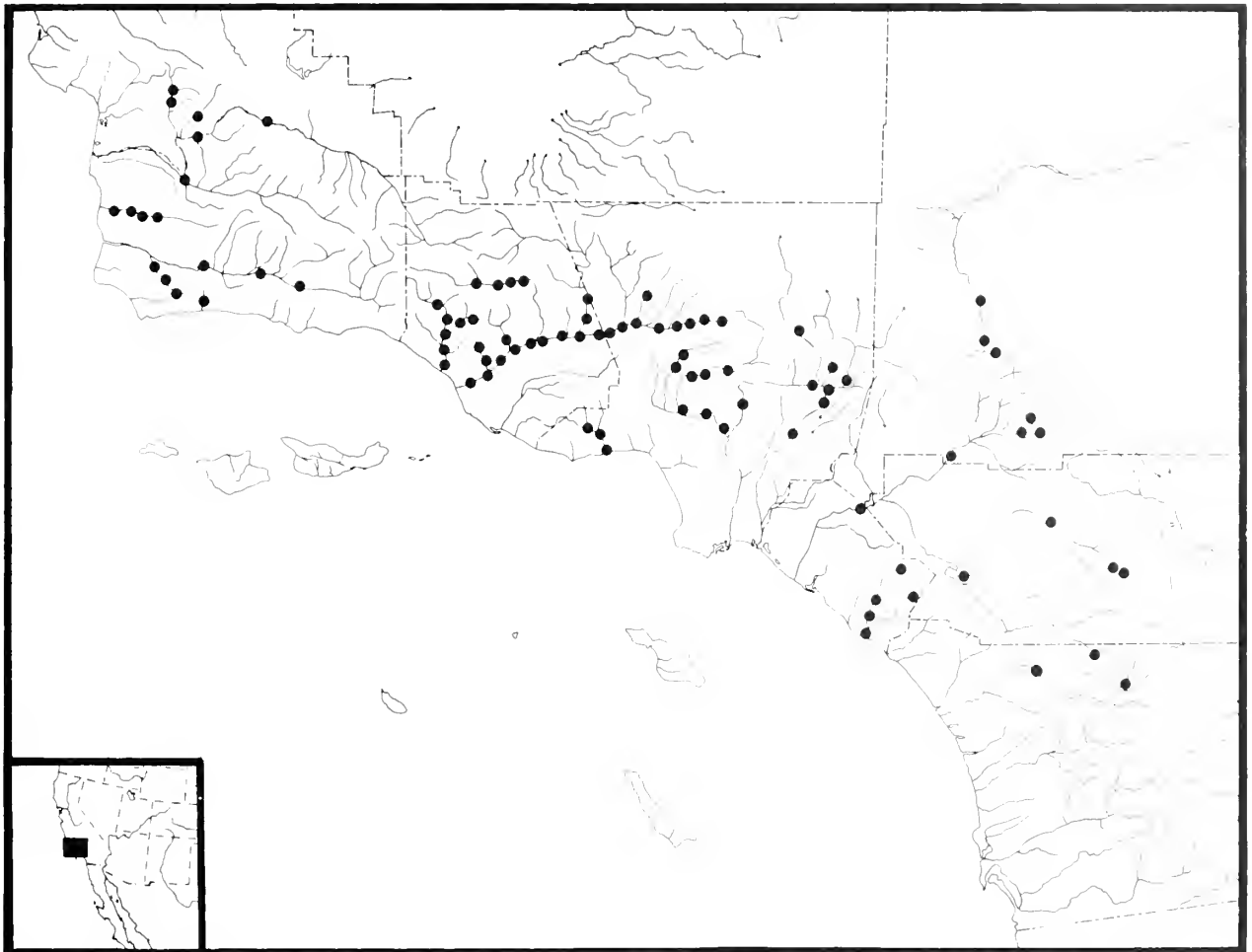
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Temecula River, Riverside, Riverside Co., CA (Eigenmann and Eigenmann 1893. Proc. Calif. Acad. Sci. [1890-92] 2:1-24).

SYSTEMATICS: Close relative of *G. purpurea* and both placed in subgenus *Temeculina* by some (Miller 1945. Copeia: 104-10). Known to undergo mass hybridization with both *G. mohavensis* and *Lavinia symmetricus* under stressed conditions (Hubbs and Miller 1943. Pap. Mich. Acad. Sci. Arts Lett. 18:343-78; Greenfield and Deckert 1973. Copeia: 417-27; Greenfield and Greenfield 1972. Copeia: 849-59).



CA: Los Angeles Co., Santa Clara River, 89 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Southern CA coastal drainages from Malibu Creek (possibly introduced) and Los Angeles River south to San Luis Rey River. Widely introduced north to Santa Inez River and Mojave River of Death Valley drainage. Found in small to moderate-sized, moderate to high gradient streams, and requires some flow (Culver and Hubbs 1917. Lorquina:82-83; Miller 1968. Calif. Fish Game 54:170-79; Bell 1978. Nat. Hist. Mus. Los. Ang. Cty. Contrib. Sci. 295:1-20).

ADULT SIZE: Usually less than 12 cm TL, 30 cm TL maximum.

BIOLOGY: Midwater and benthic in streams, becoming increasingly secretive with age. Lives three and possibly four years. Breeds in April and May and feeds on aquatic insects, snails, and some algae (Greenfield and Greenfield 1972).

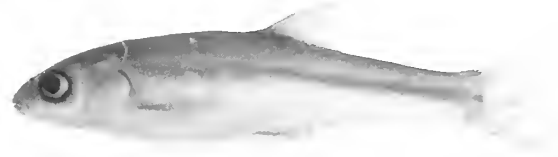
Compiler: C. C. Swift. January 1979.

Gila pandora (Cope)
Rio Grande chub

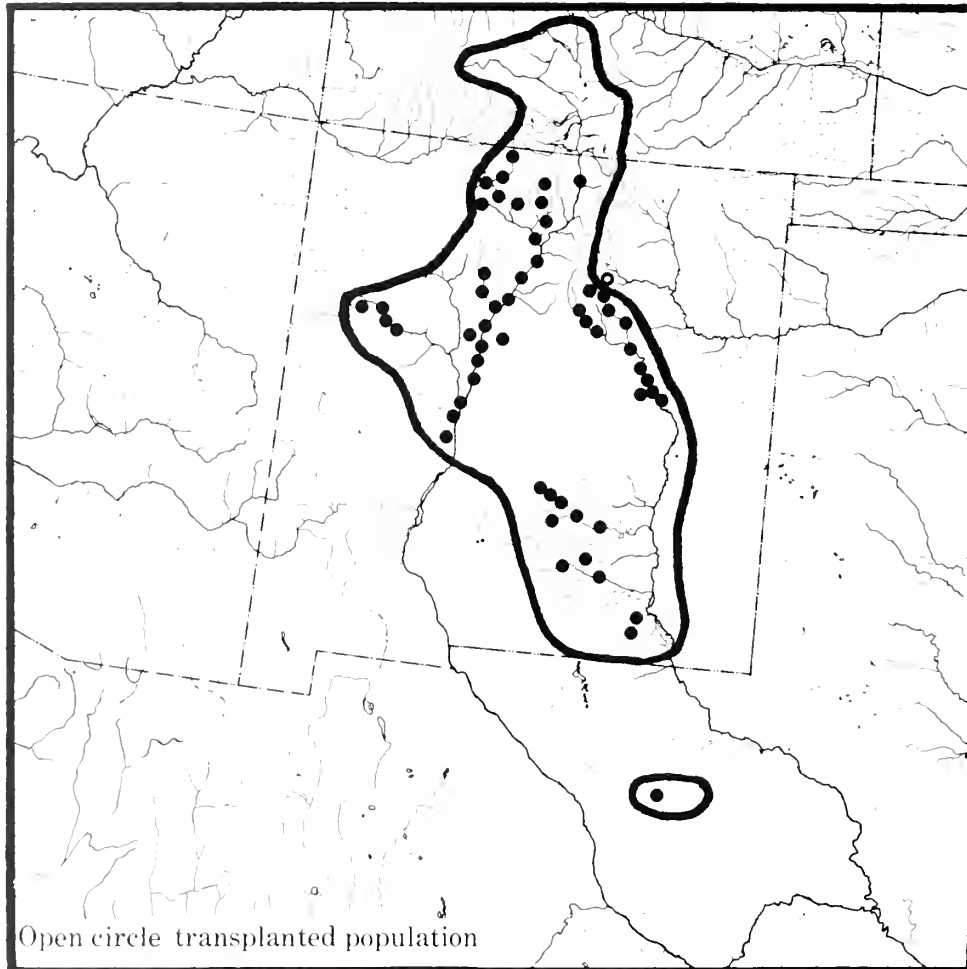
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Sangre de Cristo Pass, NM (Rio Grande basin) (Cope 1872. Report on the recent reptiles and fishes of the survey. . . in U.S. Geological Survey of Montana and portions of adjacent territories. Part IV:1-538).

SYSTEMATICS: Near *G. nigrescens* from Laguna de Guzman basin, northwestern Chihuahua, Mexico, and southern NM, with which long confused (Miller and Hubbs 1962. Tex. J. Sci. 14: 111-13).



NM: Lincoln Co., Rio Hondo,
53 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Formerly widespread in creeks of upper Rio Grande and Pecos watersheds, NM, and Rio Grande in southern CO (Beckman 1963. *Guide to the Fishes of Colorado*), isolated population in Davis Mountains, TX (Koster 1957. *Guide to the Fishes of New Mexico*; Miller and Hubbs 1962). Sublette (1975. N.M. Game Fish Dept. Rept.) demonstrated range reduction in Pecos system and reported first records from Canadian River basin, NM, where likely introduced. Most common in pools of small to moderate-sized tributaries, often near inflow of riffles and in association with cover such as undercut banks and plant debris.

ADULT SIZE: Rarely exceeds 150 mm SL.

BIOLOGY: Essentially unknown. Limited discussion by Koster (1957). Often heavily infested by external parasites when crowded into intermittent pools (pers. obser). Hybridizes with *Rhinichthys cataractae* (Cross and Minckley 1960. Univ. Kans. Publ. Mus. Nat. Hist. 13: 1-18).

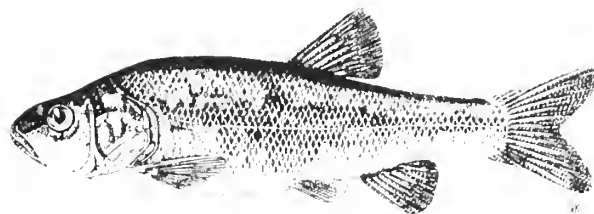
Compiler: W. L. Minckley, January 1979.

Gila purpurea (Girard)
Yaqui chub

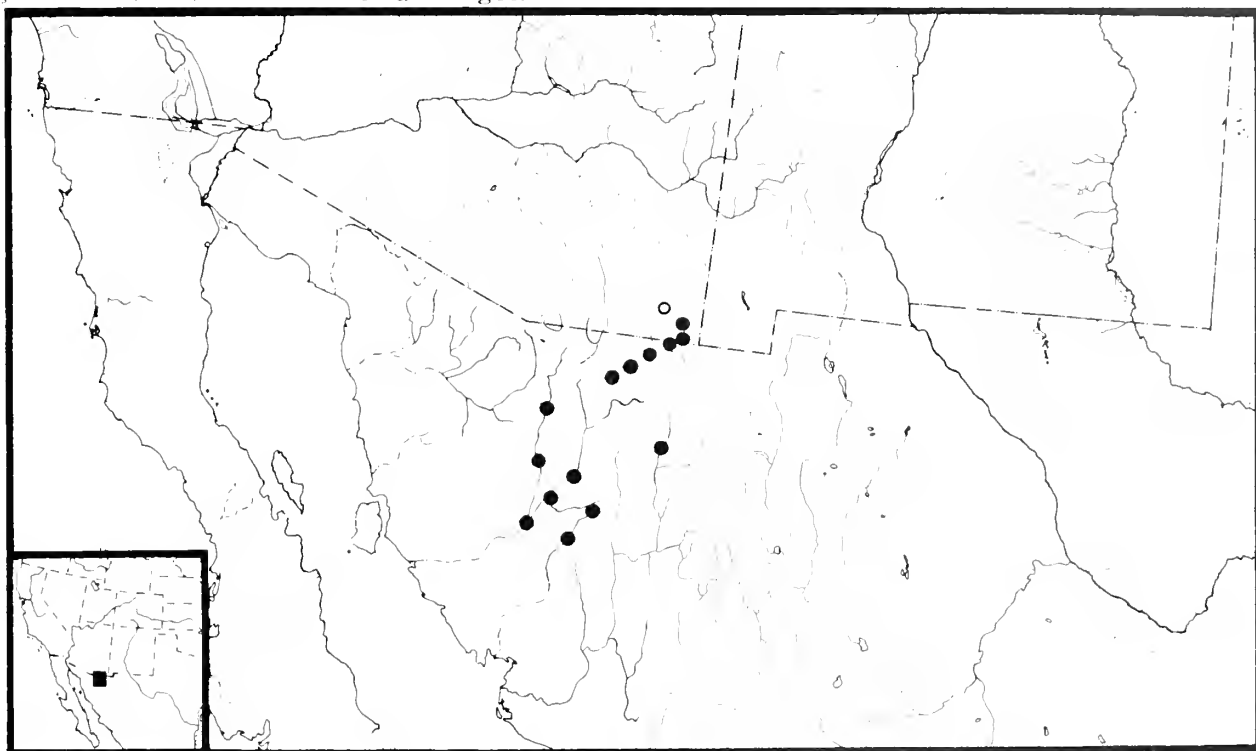
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Mexico, Sonora, Rio de San Bernardino, at United States Mexican Boundary, ca. 29 km e of Douglas, AZ, 31° 21' W (Girard 1857, Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213). Taylor (1967, Veliger 10:152-58) noted however that collections made during United States and Mexican Boundary Survey were undoubtedly on both sides of present border.

SYSTEMATICS: Subgenus *Temeculina* (Barbour and Miller 1978, Misc. Publ. Mus. Zool. Univ. Mich. 155:1-72). Miller (1945, Copeia: 104-10) considered *G. purpurea* related to *G. ditaenia* of Rio de la Concepcion (= Rio Asuncion), Sonora Mexico, and *G. orcutti* of Los Angeles Plain, CA, and associated drainages.



Mexico: Sonora, Rio Matape, female, 117 mm SL (NCSM).



Open circle transplanted population

DISTRIBUTION AND HABITAT: Smaller streams of Rios Matape, Sonora, and Yaqui systems, Sonora, Mexico. Nearly extirpated in U. S., persisting only in one artesian well in San Bernardino Creek drainage (McNatt 1974, Proc. West. Assn. State Game and Fish Comm. 54:273-79). Introduced and established in Leslie Creek, Swisshelm Mountains, AZ, in 1969 (Minckley 1973, *Fishes of Arizona*). Records from Morse Canyon, northern Chiricahua Mountains, AZ, not supported by specimens (Willcox Playa basin; McNatt 1974). Lives in deeper pools of small streams near undercut banks or debris, and often in association with higher aquatic plants.

ADULT SIZE: Rarely exceeds 100 mm.

BIOLOGY: Spawns in March and young grow to 40-50 mm SL by following year. Males steely blue during much of year, contrasting with drab, yellow-brown of females (McNatt 1974). Foods consist of algae, terrestrial insects, and arachnids in springhead habitats (Minckley 1973), but aquatic insects and small fishes (*Poeciliopsis*) are eaten when available.

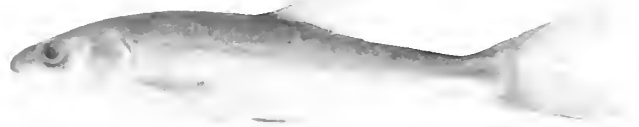
Compiler: W. L. Minckley, July 1978.

***Gila robusta* Baird and Girard**
Roundtail chub

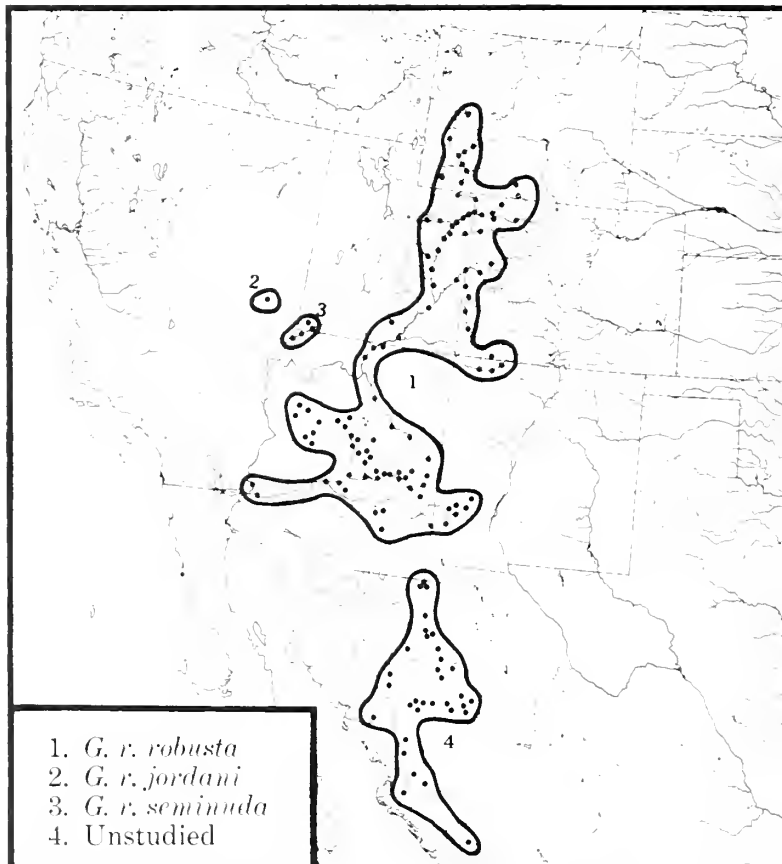
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Zuni River, NM (Baird and Girard 1853, Proc. Acad. Nat. Sci. Phila. [1853-53]6:387-90). Type locality undoubtedly in error, most likely Little Colorado River below Grand Falls (Smith et al. 1979, Proc. 1st. Conf. Sci. Res. Nat. Parks 1:613-23).

SYSTEMATICS: Subgenus *Gila*. Smith et al. (1979) reviewed systematics of this and closely related *G. elegans* and *G. cypha*, defining their specific identities. Subspecies include *G. r. jordani* (Pluvial White River, NV), *G. r. seminuda* (Virgin River, UT, AZ, NV), *G. r. robusta* (widespread in upper and lower Colorado River basin), *G. r. grahami* (tributaries of Gila River, AZ, NM) (Rinne 1976, Wassman J. Biol. 34:65-107), and nominal forms in Mexico (Miller 1976, Fieldiana Zool. 69:1-31).



NM: Grant Co., tributary to
Gila River, 116 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Warm streams and larger tributaries of Colorado River basin where replaced by *G. elegans* in largest river channels (Holden and Stalnaker 1975, Trans. Am. Fish. Soc. 104:217-31; Rinne 1976), south through Rio Yaqui basin, to Rio Piaxtla, Sinaloa, Mexico (Smith et al. 1979). Locally abundant in channels of large rivers or in association with cover such as boulders or overhanging cliffs or vegetation in smaller streams.

ADULT SIZE: 250-350 mm SL.

BIOLOGY: Vanicek and Kramer (1969, Trans. Am. Fish. Soc. 98:193-208) studied age and growth, food habits, and spawning times in Green River, UT and CO. LaRivers (1962, *Fishes and Fisheries of Nevada*) and Minckley (1973, *Fishes of Arizona*) gave general accounts.

Compilers: P. B. Holden and W. L. Minckley,
March 1980.

Hemitremia flammea (Jordan and
Gilbert)
Flame chub

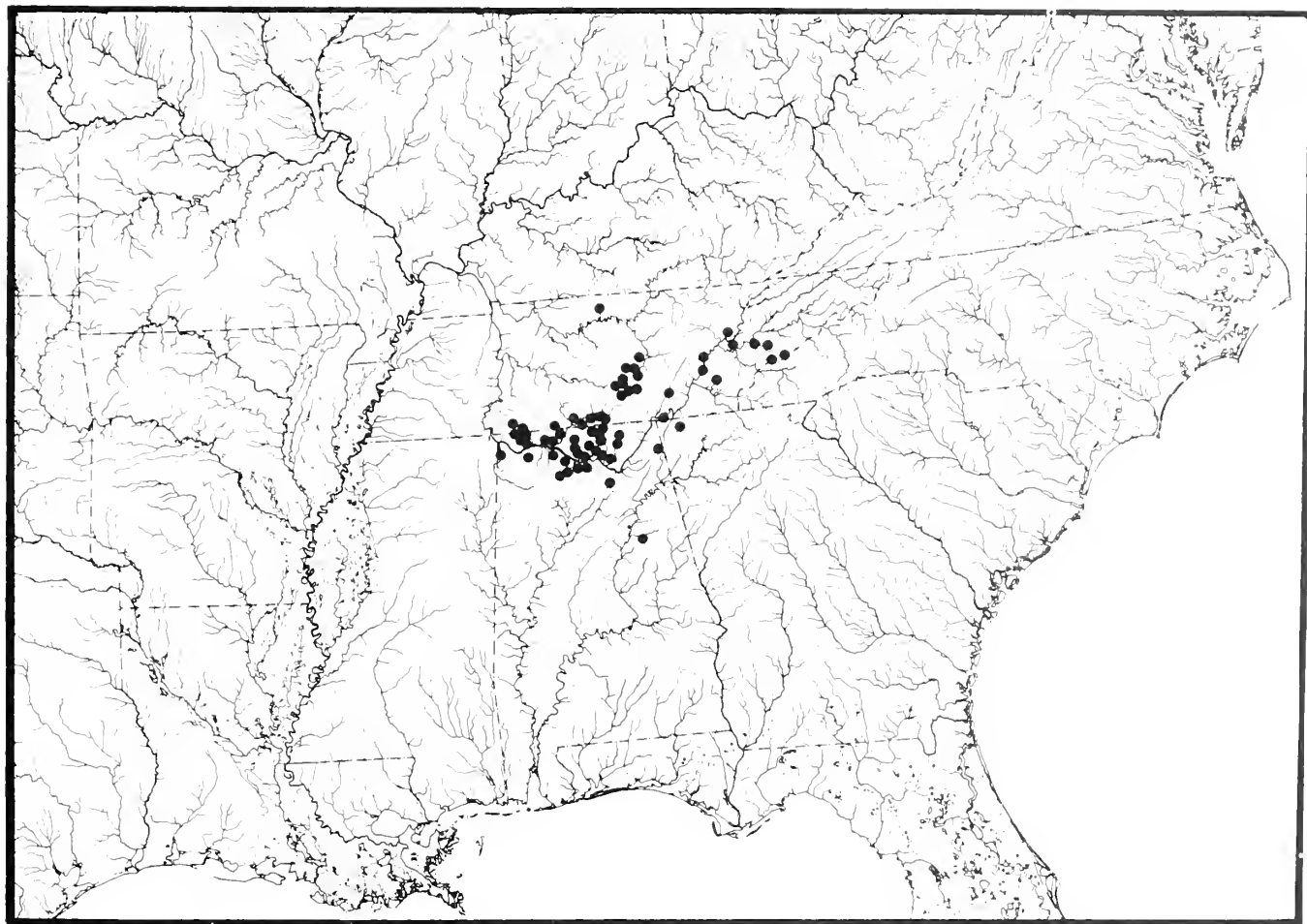
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Elk River, Estill Springs, TN (Jordan and Gilbert in Jordan 1878. *Manual of Vertebrates of the Northern United States* 2:1-407).

SYSTEMATICS: Monotypic genus of uncertain relationships.



AL: Madison Co., Tennessee
River system, 46 mm SL
(Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Tributaries of middle Cumberland, upper Duck, and middle Tennessee rivers in TN, AL, and GA. Also known from one locality, a spring tributary to Kelley Creek, a tributary to Choccolocco Creek, in Coosa River system, AL. Based on analysis of 148 UAIC collections, size of streams, substrate and current vary widely, but one common stream characteristic is presence of spring water. Relatively rare throughout most of range, but quite common in Cypress Creek Watershed, Lauderdale Co., AL, and Wayne Co., TN.

ADULT SIZE: 60 mm SL maximum.

BIOLOGY: Spawning (in south bend area of Tennessee River) occurs late December to early June, probably peaking in February and March. Large, ripe females collected in seepage areas of the kind used by *Etheostoma boschungii*, but are not known to spawn there. Food almost entirely aquatic and terrestrial insects.

Compiler: H. T. Boschung, July 1979.

***Hybognathus argyritis* Girard**
Western silvery minnow

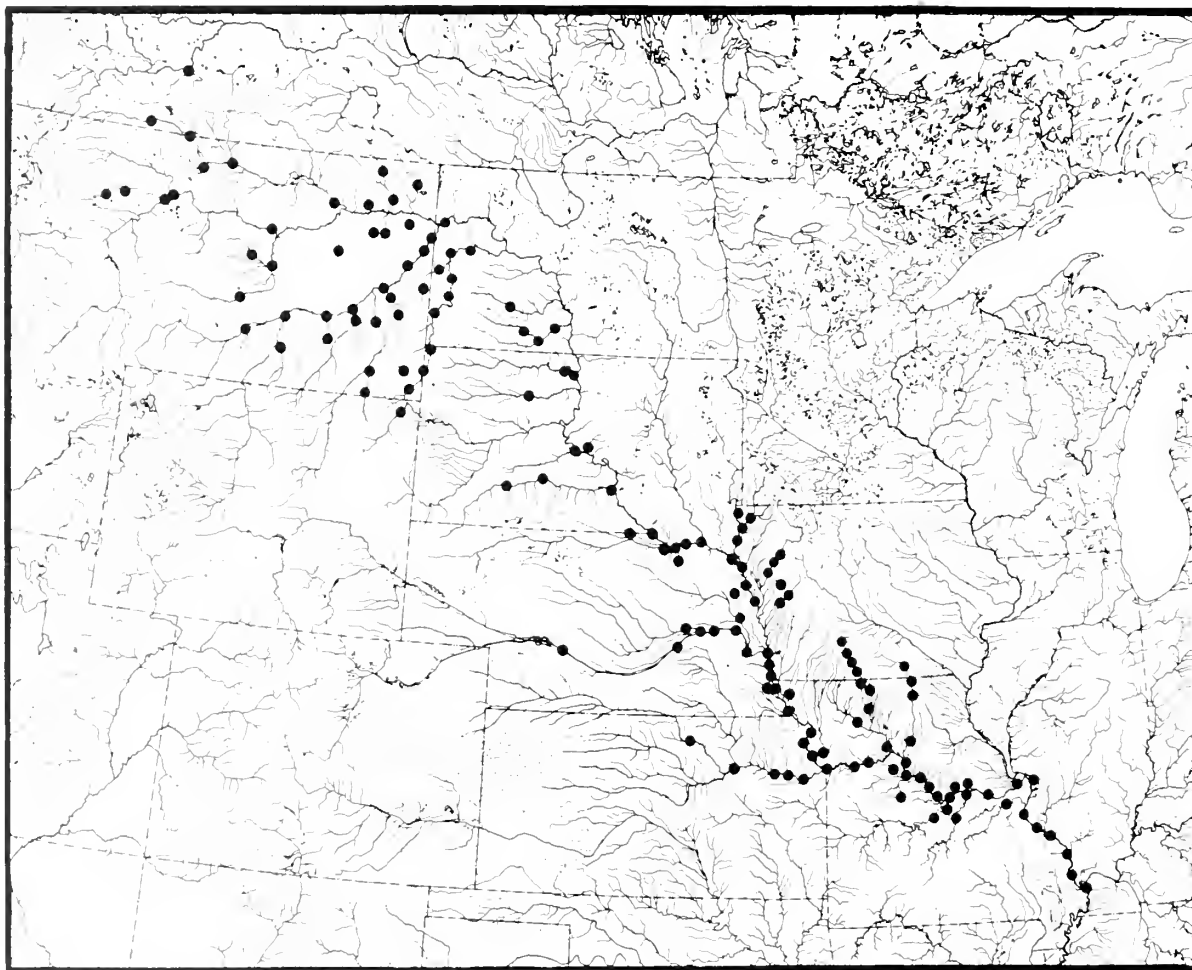
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Milk River, MT (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8: 165-213).

SYSTEMATICS: Treated as synonym of *H. nuchalis* by most early workers (e.g., Hubbs and Ortenburger 1929. Publ. Univ. Okla. Biol. Surv. 1:45-112). Recently accorded full specific status (Pflieger 1971. Univ. Kans. Publ. Mus. Nat. Hist. 20:225-470).



MO: Boone Co., Missouri
River, 68.5 mm SL (Mo. Dept.
Cons.).



DISTRIBUTION AND HABITAT: From South Saskatchewan River, AT to MB, southeast in Missouri Basin to confluence of Missouri and Mississippi rivers, then south in latter (where sympatric with *H. nuchalis*) to mouth of Ohio River. Abundant in backwaters and pools of large, silty, plains streams.

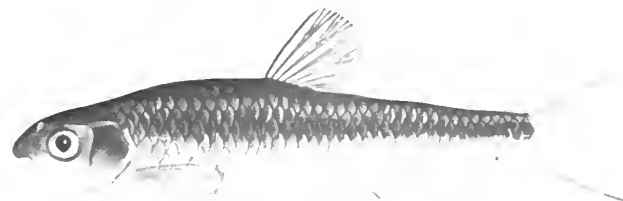
ADULT SIZE: 75-125 mm TL.

BIOLOGY: Not known, but probably like that of *H. nuchalis*, the central silvery minnow.

Compiler: W. L. Pflieger. July 1978.

***Hybognathus hankinsoni* Hubbs**
Brassy minnow

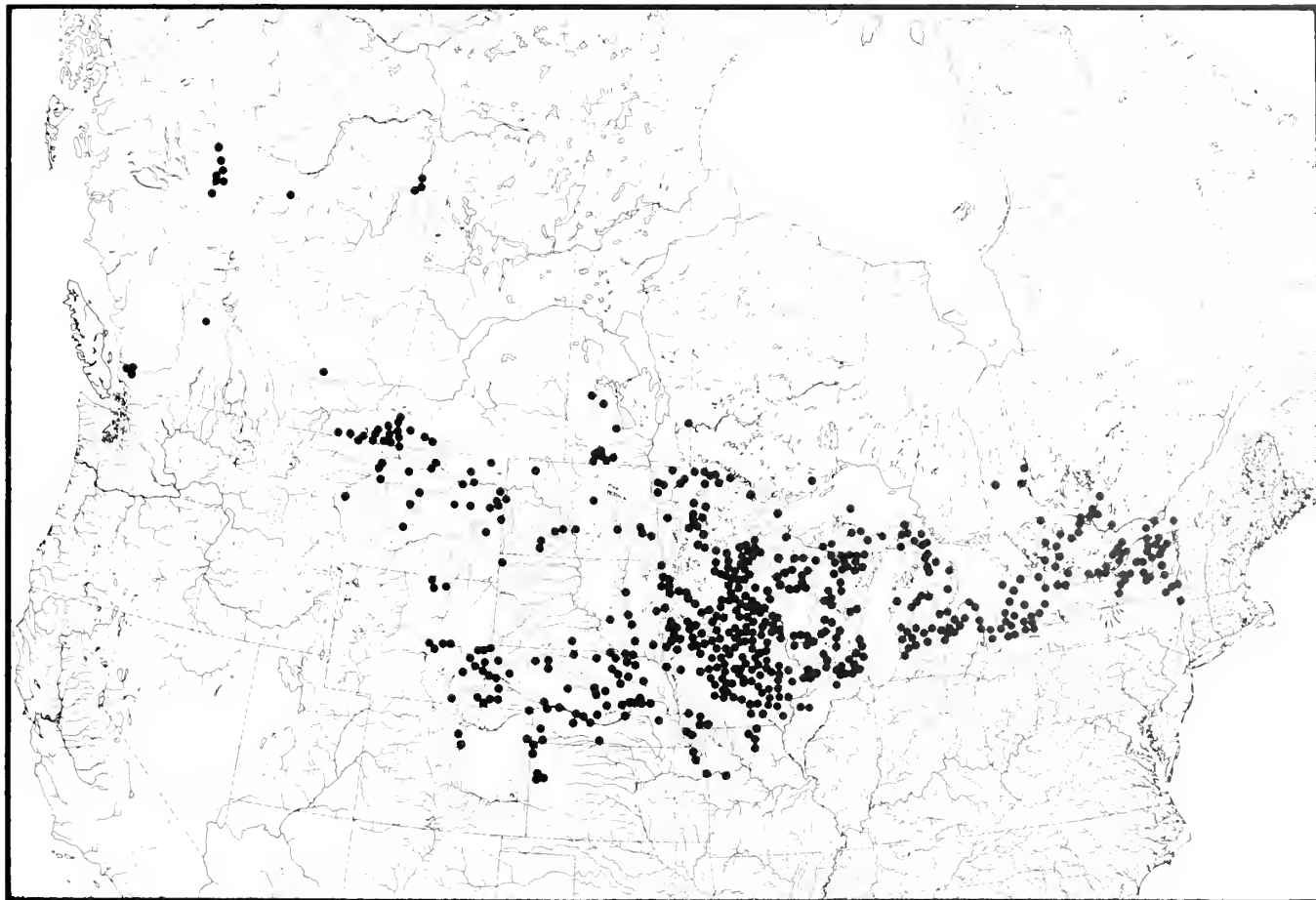
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: Original description by Hubbs (in Jordan 1929, *A Manual of the Vertebrate Animals of the Northeastern United States*). Dead River, T48N,R26W, sec. 8, Marquette Co., MI, designated lectotype by Bailey (1954, *Copeia*: 289-91).

SYSTEMATICS: Genus needs revision. Four to six species recognized, depending on authority. No definitive study published on systematics.

IL: Stephenson Co., North Branch Otter Creek, 62 mm SL (Smith 1979, *The Fishes of Illinois*).



DISTRIBUTION AND HABITAT: Common species from upper St. Lawrence River and Lake Champlain region of NY, west through Great Lakes, upper Mississippi, and Missouri basins, and north to AT; somewhat disjunct in BC in Fraser and Peace rivers. Considered native to BC waters. Fossil remains from southwestern KS (Smith 1963, *Copeia*: 278-85) indicate former more southern distribution. Typically inhabits small, sluggish weedy creeks or streams with sand, gravel, or mud bottom overlain by organic sediment. Also common in cool, stained or acid waters of bog streams and lakes.

ADULT SIZE: 55-97 mm TL.

BIOLOGY: Food habits and other general ecological information analyzed by Dobie et al. (1948, *U.S. Fish Wildl. Ser. Circ.* 12:1-113), Starrett (1950, *Ecol.* 31:216-33), Dobie et al. (1956, *U.S. Fish Wildl. Serv. Circ.* 35:1-123) and McPhail and Lindsey (1970, *Freshwater Fishes of Northwestern Canada and Alaska*). Recent detailed study of a WY population (Copes 1975, *Mus. Nat. Hist. Univ. Wis. Stevens Point. Rep. Fauna Flora Wis.* 10:46-72) reported on behavior, food habits, reproduction, age and growth, parasites, predation and other general ecology.

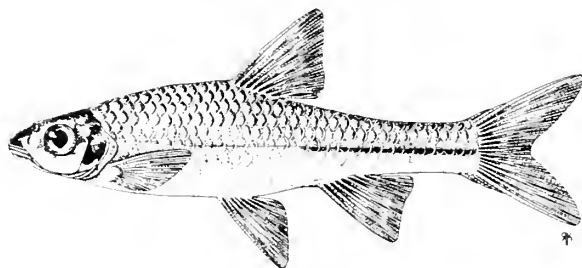
Compiler: B. M. Burr. November 1978.

Hybognathus hayi Jordan
Cypress minnow

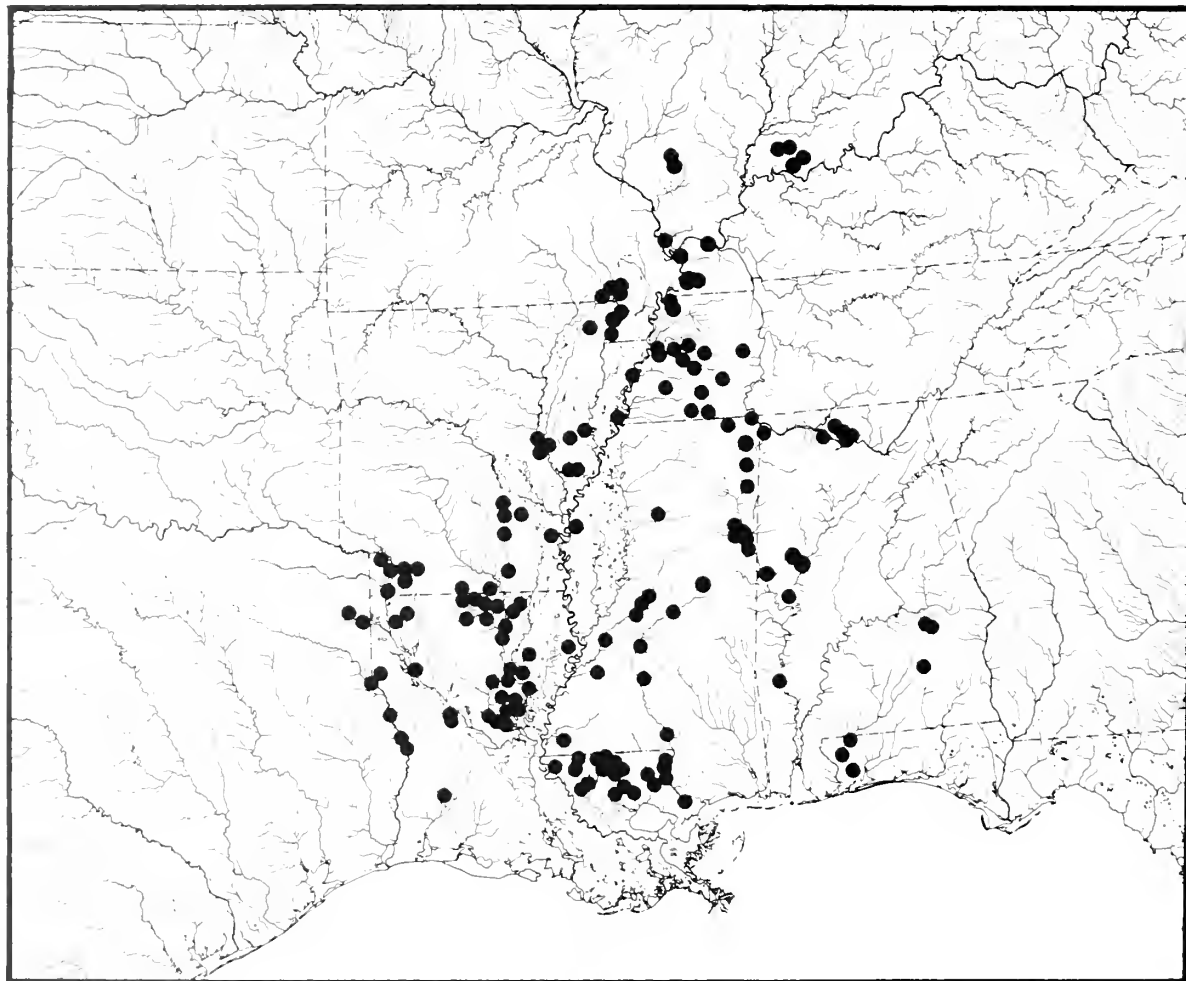
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Pearl River, at Jackson, Hinds, and Rankin cos., MS (Jordan 1885. Proc. U. S. Natl. Mus. [1884] 7:548-50).

SYSTEMATICS: Similar in appearance to *H. nuchalis*, with which it frequently occurs. Fingerman and Suttkus (1961, Copeia: 462-67) presented detailed morphological comparison of both species.



(NCSM)



DISTRIBUTION AND HABITAT: Gulf slope, from Sabine River drainage, TX and LA, east to Escambia River drainage, FL and AL (excluding certain minor intervening drainages: Biloxi and St. Louis bays, Escatawpa and Perdido rivers). North in Mississippi Valley to southern IL and extreme southwestern IN. Sometimes common in preferred habitat, but apparently extirpated from some areas in northern parts of range (e.g., southeastern MO). Lowland species that inhabits sluggish pools and backwaters of low-gradient streams.

ADULT SIZE: Maximum size at least 95 mm SL.

BIOLOGY: Not studied. Aspects of feeding and spawning presumably similar to those of other species of *Hybognathus*.

Compiler: C. R. Gilbert. November 1978.

Hybognathus nuchalis Agassiz
Central silvery minnow

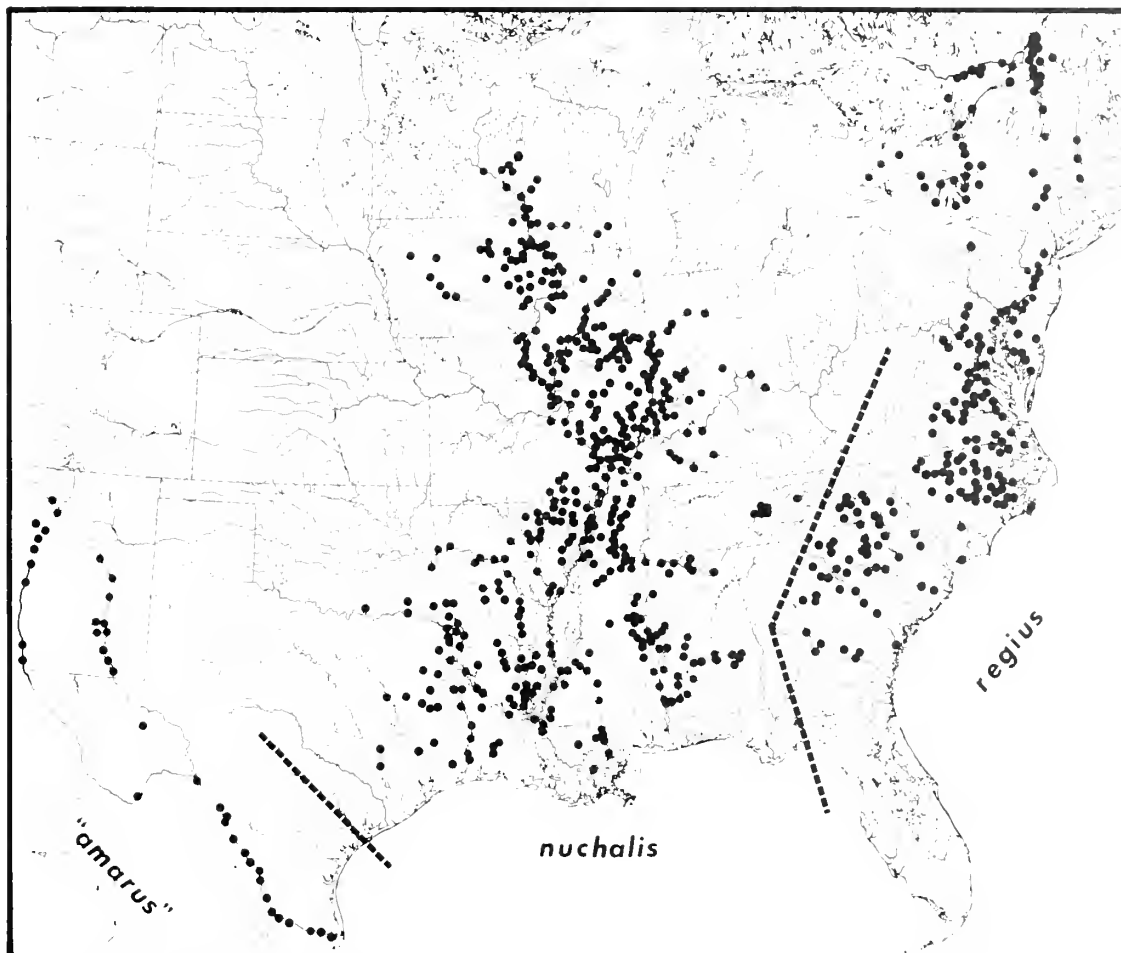
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Quincy, IL (Agassiz 1855. Am.J. Sci. Arts 19 [2nd Ser.] :215-31).

SYSTEMATICS: *Hybognathus nuchalis*, as treated here, is a complex of three nominal forms of uncertain relationship: *H. nuchalis* of Mississippi basin and adjacent Gulf slope drainage; *H. regius* of Atlantic slope; and *H. amarus* of Rio Grande drainage. These forms are morphologically distinct and allopatric, and perhaps could be accorded full specific status. Pflieger (1971. Univ. Kans. Publ. Mus. Nat. Hist. 20:225-570) recently removed *H. argyritis* from synonymy of *H. nuchalis*.



MO: Ripley Co., Current River,
62.5 mm SL (Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: St. Lawrence and Lake Ontario drainages south on Atlantic slope to Altamaha drainage, GA (*H. regius*); Mississippi basin from MN south to Brazos River, TX, and Mobile Bay drainage, AL (*H. nuchalis*); Rio Grande drainage of NM and TX (*H. amarus*). Common in pools and backwaters of medium to large streams with low or moderate gradients. Less abundant than formerly in parts of its range, and probably extirpated from OH, eastern TN, and MN.

ADULT SIZE: 75-175 mm TL.

BIOLOGY: In large schools near bottom, ingesting mud and bottom ooze from which it digests algae and other organic matter (Forbes and Richardson 1920. Ill. Nat. Hist. Surv. 3:1-357). Non-adhesive eggs are scattered on silt substrate in quiet water of coves, in early summer in NY (Raney 1939. Am. Midl. Nat. 21:674-80).

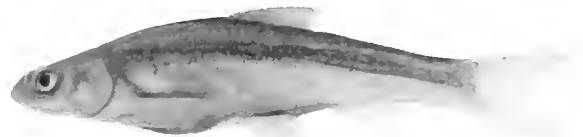
Compiler: W. L. Pflieger. July 1978.

Hybognathus placitus Girard
Plains minnow

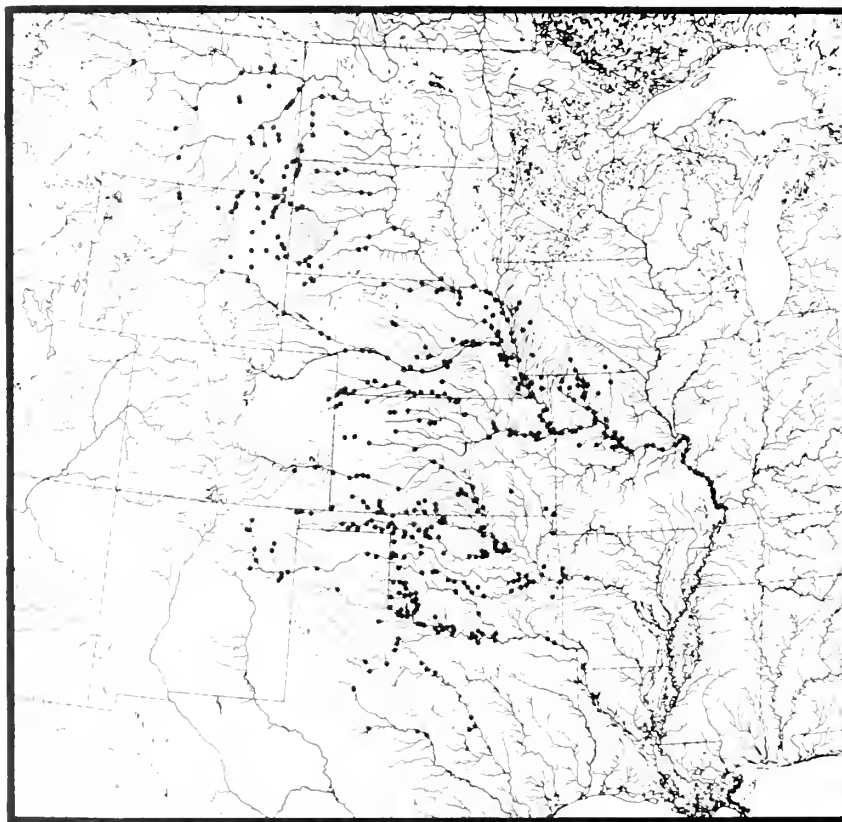
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Arkansas River, near Fort Makee (= Fort Atkinson), near Cimarron, Gray Co., KS (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8: 165-213).

SYSTEMATICS: Very similar in appearance to *H. nuchalis* and *H. argyritis*, and may occur with either or both. Regarded by Bailey (in Harlan and Speaker 1951. *Iowa Fish and Fishing*:187-238) as ecophenotypic variant of *H. nuchalis*, a premise refuted by findings of Niazi and Moore (1962. Southwest. Nat. 7: 41-50) who were first to note differences in morphology of basioccipital bone in the two species. Bailey and Allum (1962. *Fishes of South Dakota*) and Al-Rawi and Cross (1964. Trans. Kans. Acad. Sci. 67: 154-68) illustrated these differences and published on variation.



NM: Quay Co., Canadian River, 53 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Central TX (Colorado and Brazos river drainages) north in Great Plains area to MT and ND. East down Missouri River and into Mississippi River proper, where may occasionally occur downstream as far as southwestern IL and western KY, near mouth of Ohio River. Characteristically in open, shallow river channels with sand bottom, where is often quite abundant.

ADULT SIZE: ca. 50-90 mm TL. Maximum size no more than 125 mm TL.

BIOLOGY: Cross (1950. Am. Midl. Nat. 43: 128-45; 1958. *Data for Handbook of Biological Data* : 1-14; 1967. *Handbook of Fishes of Kansas*) reported on various aspects of biology. Diet, as in all species of *Hybognathus*, is herbivorous, with the food consisting of microscopic plant material (mainly diatoms?) that is picked off the sandy substrate. Reproductive habits not described, but spawning probably communal, with eggs scattered over substrate. Breeding season protracted, April into August.

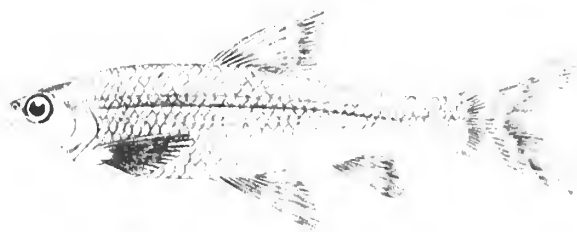
Compiler: C. R. Gilbert. November 1978.

Hybognathus regius Girard
Eastern silvery minnow

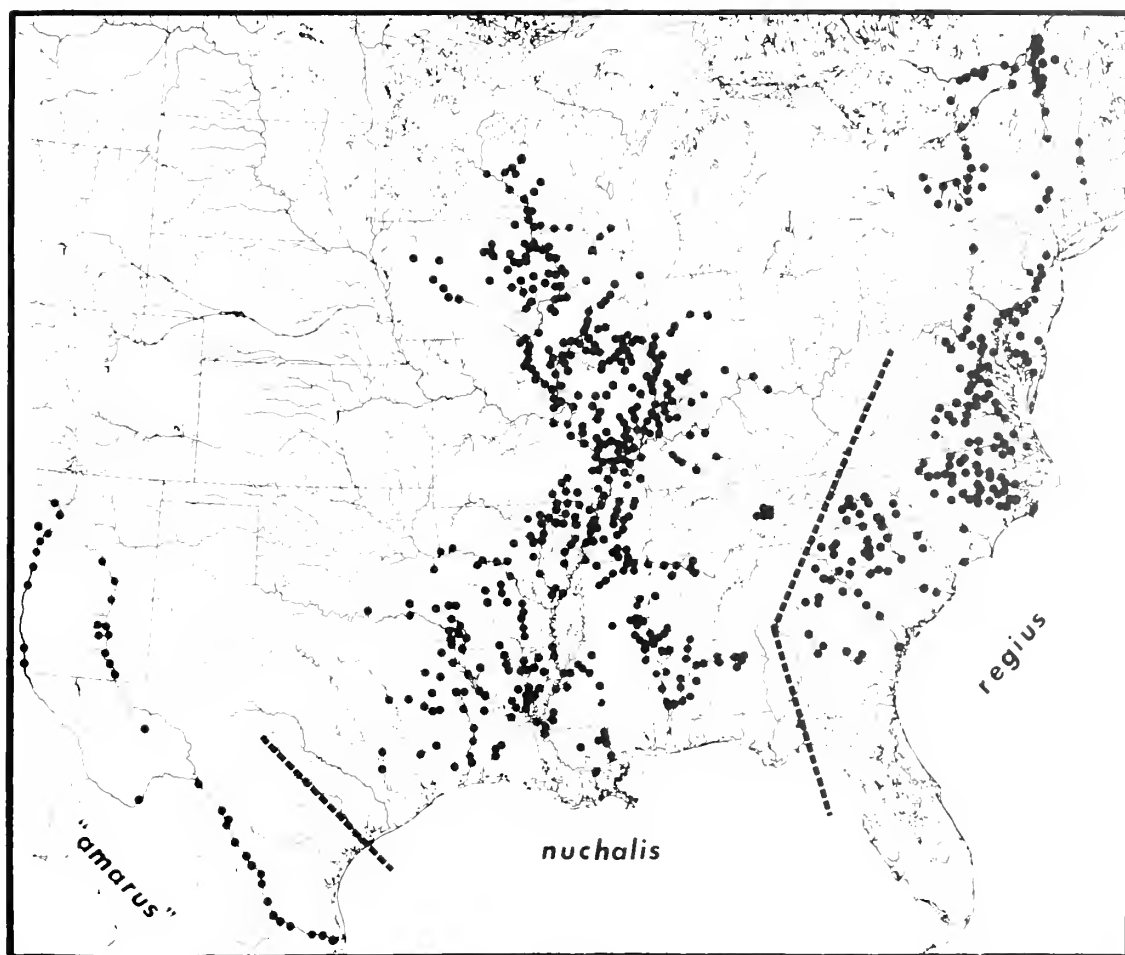
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Not definitely stated. "Inhabits the Potomac River, and probably all the fresh waters of Maryland" (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Atlantic slope representative of a complex of three (possibly four) distinct, allopatric forms of uncertain relationships. This form and *H. nuchalis* covered herein, whereas *H. amarus* is not. This decision parallels that of current AFS checklist committee. Status of *H. regius* still needs clarification (also see systematics section of *H. nuchalis*).



MD: Harford Co.,
108 mm TL (NCSM).



DISTRIBUTION AND HABITAT: See *H. nuchalis* account.

BIOLOGY: Spawns diurnally in late April and early May at 13°-20.5°C in NY. Females spawn at one year of age, males in second year (Raney 1939. Am. Midl. Nat. 21:674-80). Although detailed food studies not available, algae and bottom ooze seem to constitute the main food.

ADULT SIZE: 55-120 mm TL.

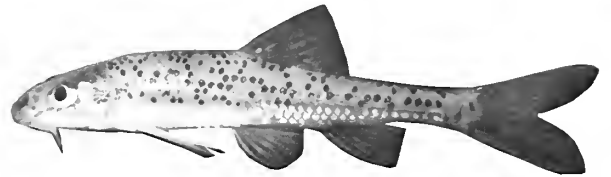
Compiler: D. S. Lee, August 1979.

Hybopsis aestivalis (Girard)
Speckled chub

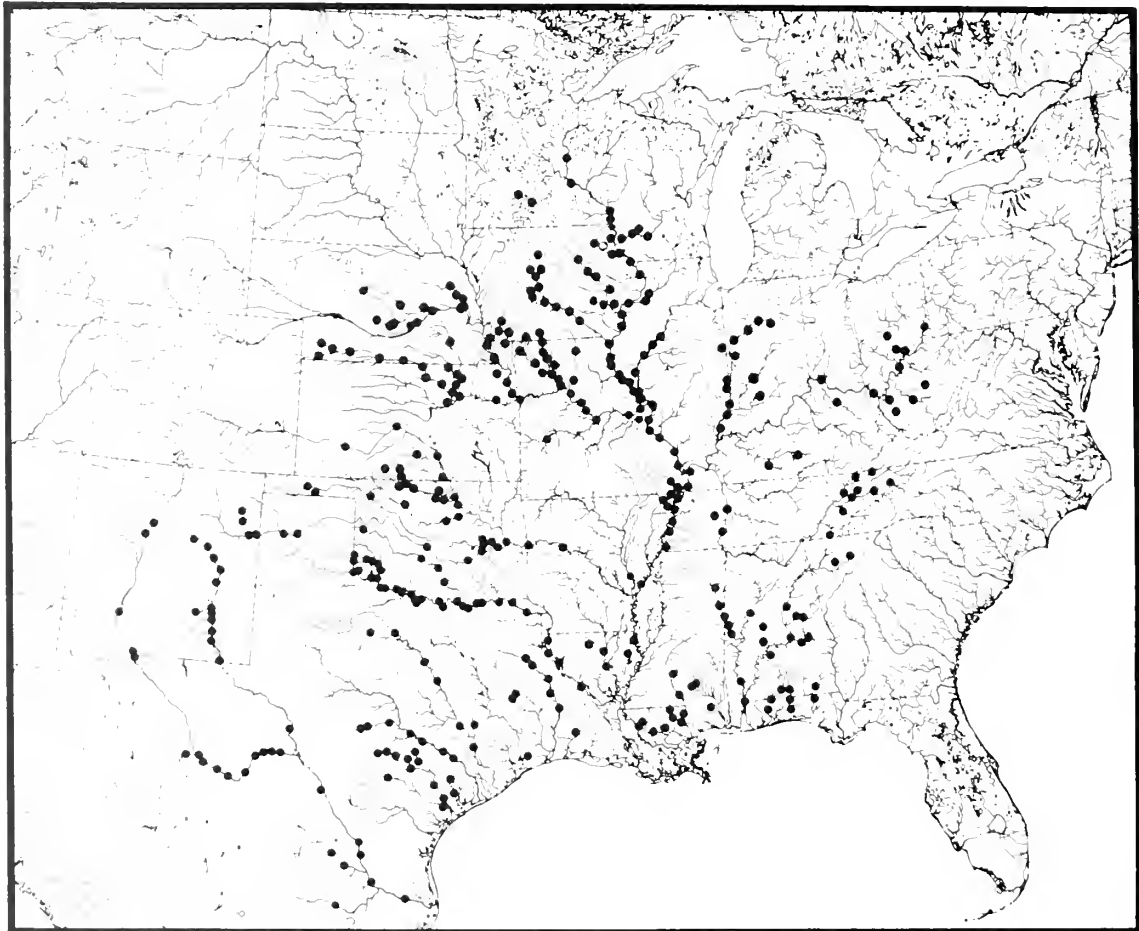
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio San Juan, near Cadereita, Nuevo Leon (Girard 1857. Proc. Acad. Nat. Sci. [1856] 8:165-213).

SYSTEMATICS: Six nominal subspecies: *H. a. hyostomus*, *H. a. marconis*, *H. a. aestivalis*, *H. a. sterletus*, *H. a. tetranemus*, and *H. a. australis*. No critical review of relationships or status of subspecies published. Some populations highly variable (Hubbs and Ort-enburger 1929. Publ. Univ. Okla. Biol. Surv. 1:17-43; Reno 1969. Copeia: 736-73). Geographic variation in *H. a. tetranemus* barbel characteristic noted by Suttkus and Yerger (1962. Tulane Stud. Zool. 9:323-30).



MO: Grundy Co., Weldon Fork
34 mm SL (Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: Gulf of Mexico drainages west of Apalachicola River drainage to Rio Grande. Limited north to about 45th parallel. *Hybopsis a. hyostomus*, east of Mississippi River; *H. a. marconis*, San Marcos River; *H. a. aestivalis*, clear Rio Grande tributaries; *H. a. sterletus*, Rio Grande proper; *H. a. tetranemus*, Arkansas River; *H. a. australis*, Red River. In large, low gradient streams usually over fine gravel or sand.

ADULT SIZE: 45-76 mm TL.

BIOLOGY: Starrett (1950. Ecology 31:216-33) discussed food habits. Botrell et al. (1964. Trans. Am. Fish. Soc. 83:391-99) reported breeding behavior and development. General discussion of ecology by Starrett (1951. Ecology 32:13-27). Alabama specimens in spawning condition during July (Suttkus and Yerger 1962).

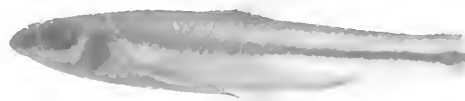
Compiler: R. K. Wallace. February 1978.

Hybopsis amblops (Rafinesque)
Bigeye chub

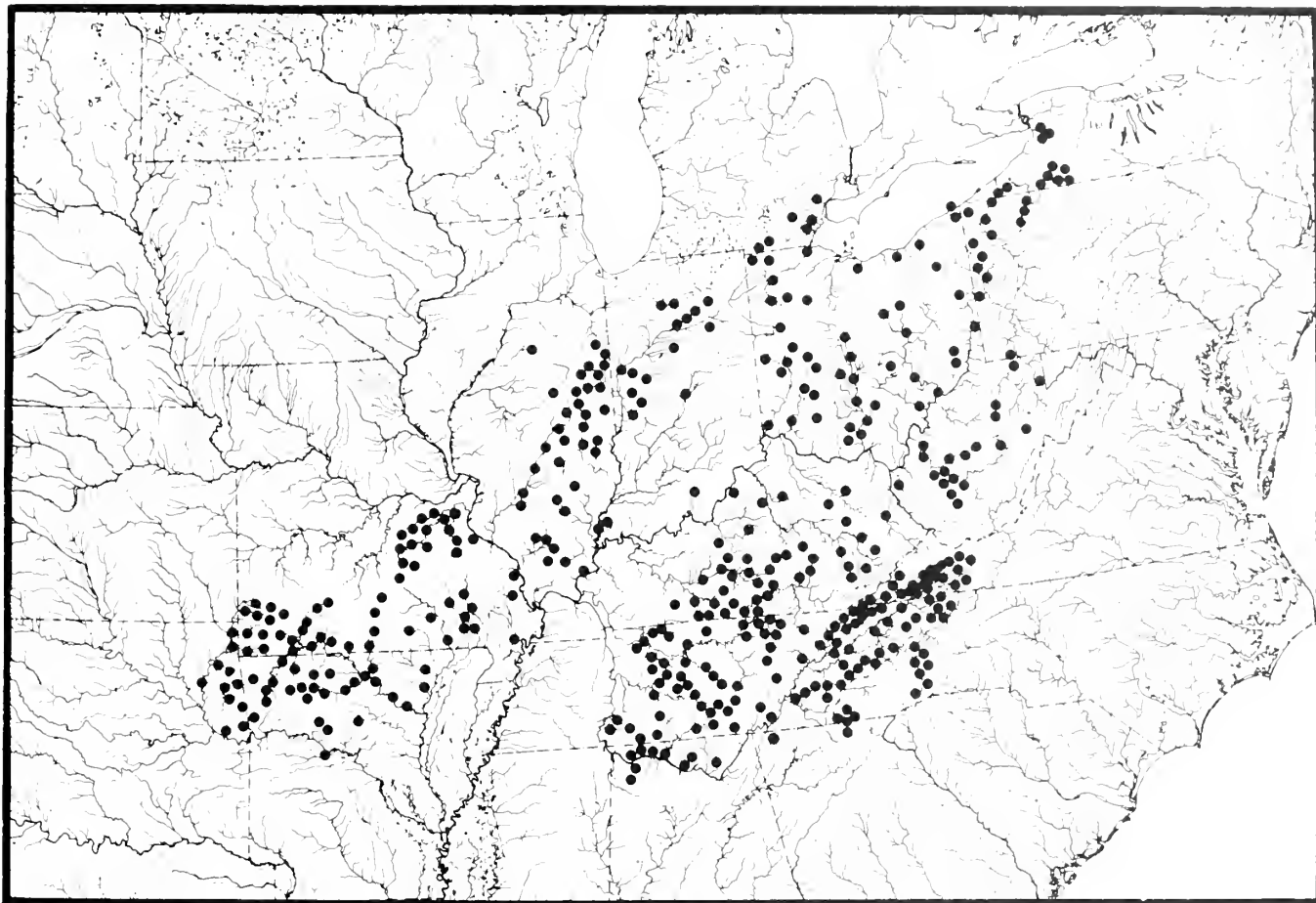
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Falls of the Ohio River at Louisville, KY (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Subgenus *Hybopsis*. Clemmer (1971. Ph.D. diss., Tulane Univ.) reviewed this and closely related *H. rubrifrons*, *H. lineapunctata*, *H. winchelli*, and *Notropis amnis* (Clemmer and Suttkus 1971. Tulane Stud. Zool. Bot. 17:21-30).



NC: Madison Co., Ivy Creek,
53 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upper half of Mississippi River basin from Tennessee River drainage of AL and TN, northeast to Lake Erie drainages in MI and to western NY. West of Mississippi River, found in central Arkansas River drainage of OK, AR, and MO, a few tributaries of Mississippi River in southern MO, and Meramec River system (lower Missouri River drainage), MO. Prefers small to moderate-sized, clear water tributaries with gravel or rocky bottom. Usually found near riffles in quiet waters; often associated with aquatic vegetation. Common to abundant in certain parts of range (e.g., eastern TN), but has declined drastically in abundance in other areas (e.g., IL, where has apparently been extirpated). Populations declining in areas of siltation and

pollution; may be extirpated over much of northern range (Pflieger 1975. *The Fishes of Missouri*; Trautman 1957. *The Fishes of Ohio*; Smith 1979. *The Fishes of Illinois*).

ADULT SIZE: 75 mm SL maximum.

BIOLOGY: Breeds late spring to early summer. Fine tubercles develop on dorsal surface of head of breeding males. Cross (1967. *Handbook of Fishes of Kansas*) reported spawning between late April and early June in KS. Forbes and Richardson (1908. *The Fishes of Illinois*) reported gravid females in June; Pflieger (1975) found breeding adults in June. Presumably feeds on aquatic insects.

Compiler: G. H. Clemmer. October 1979.

Hybopsis cahni Hubbs and Crowe
Slender chub

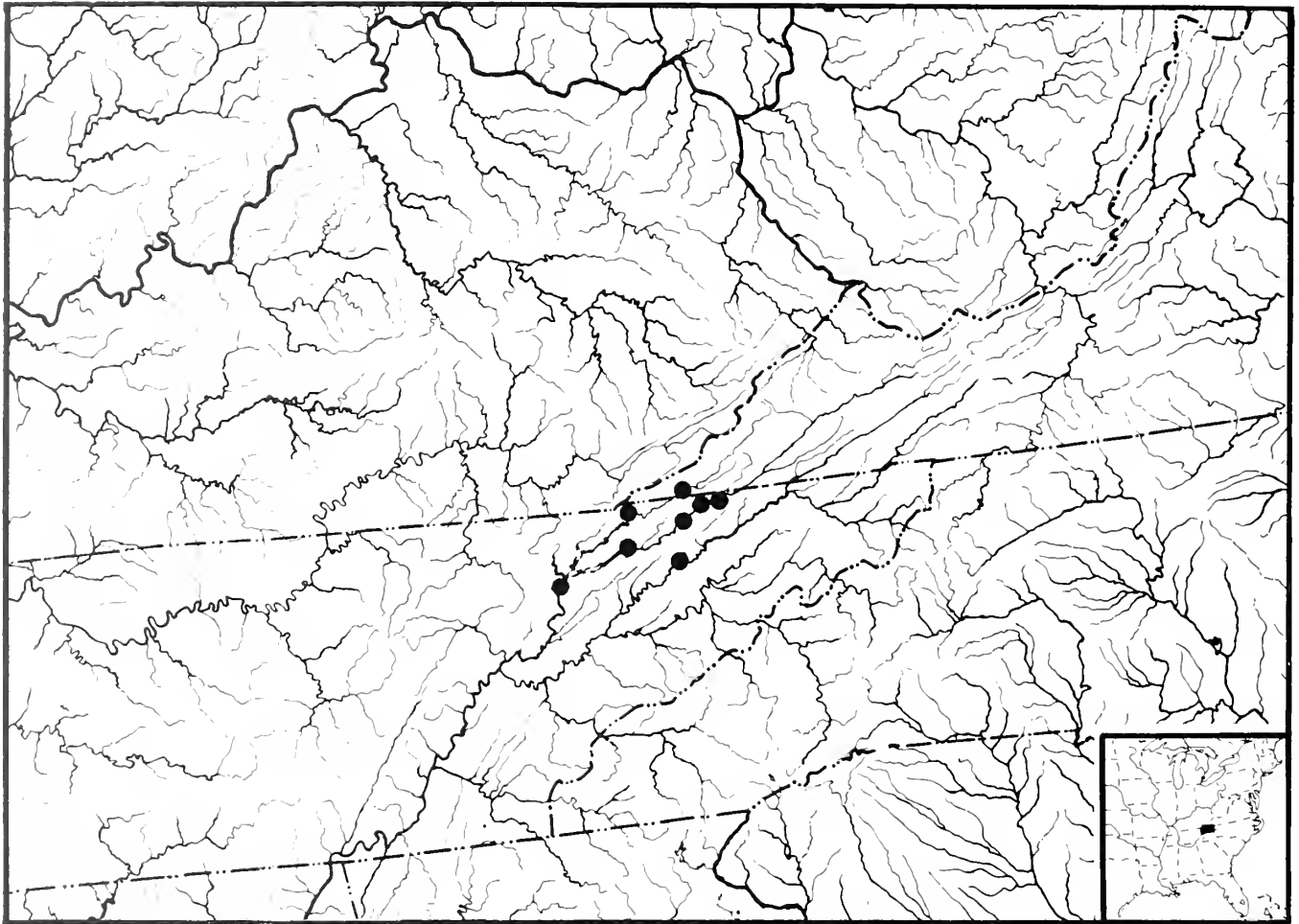
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Powell River, at hwy. 25E bridge, 4.8 km se of Harrogate, Claiborne Co., TN (Hubbs and Crowe 1956. Occas. Pap. Mus. Zool. Univ. Mich. 578:1-8).

SYSTEMATICS: Subgenus *Erimystax* (Hubbs and Crowe 1956; Reno 1969. Copeia: 736-73). Belongs in *dissimilis* group, composed also of *H. dissimilis*, *H. insignis*, and *H. x-punctata* (in part, Jenkins and Lachner 1971. Smithsonian. Contrib. Zool. 90:1-15).



TN: Claiborne Co., Powell River, female, 60 mm SL (R. E. Jenkins).



DISTRIBUTION AND HABITAT: Endemic to Ridge and Valley Province, upper Tennessee River drainage, TN. Known from lower Holston River, Hamblen Co., lower and middle Clinch River, Anderson to Hancock Co., and lower Powell River, Claiborne Co. Construction of impoundments has resulted in range apparently being reduced to Clinch River in Hancock Co., and Powell River at type locality. Probably occupied Clinch River in VA but extirpated by excessive sedimentation and chemical wastes. Inhabits medium to fairly large, warm rivers, where restricted to major bars and shoals of fine to medium gravel in moderate to swift currents. Usually rare but occasionally common at certain localities.

ADULT SIZE: 50-75 mm SL.

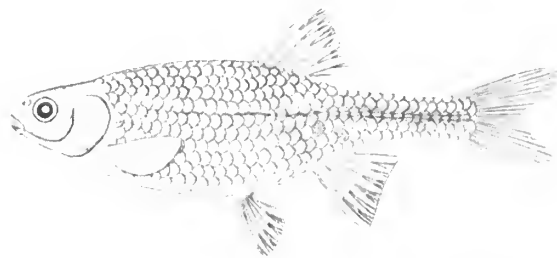
BIOLOGY: Consumes immature aquatic insects, small bivalves, and snails. Longevity ca. four years, maturing before second spring following the year of hatching. Apparently spawns in May, based on condition of preserved specimens.

Compilers: R. E. Jenkins, N. M. Burkhead, and D. A. Etnier. July 1978.

***Hybopsis crameri* (Snyder)**
Oregon chub

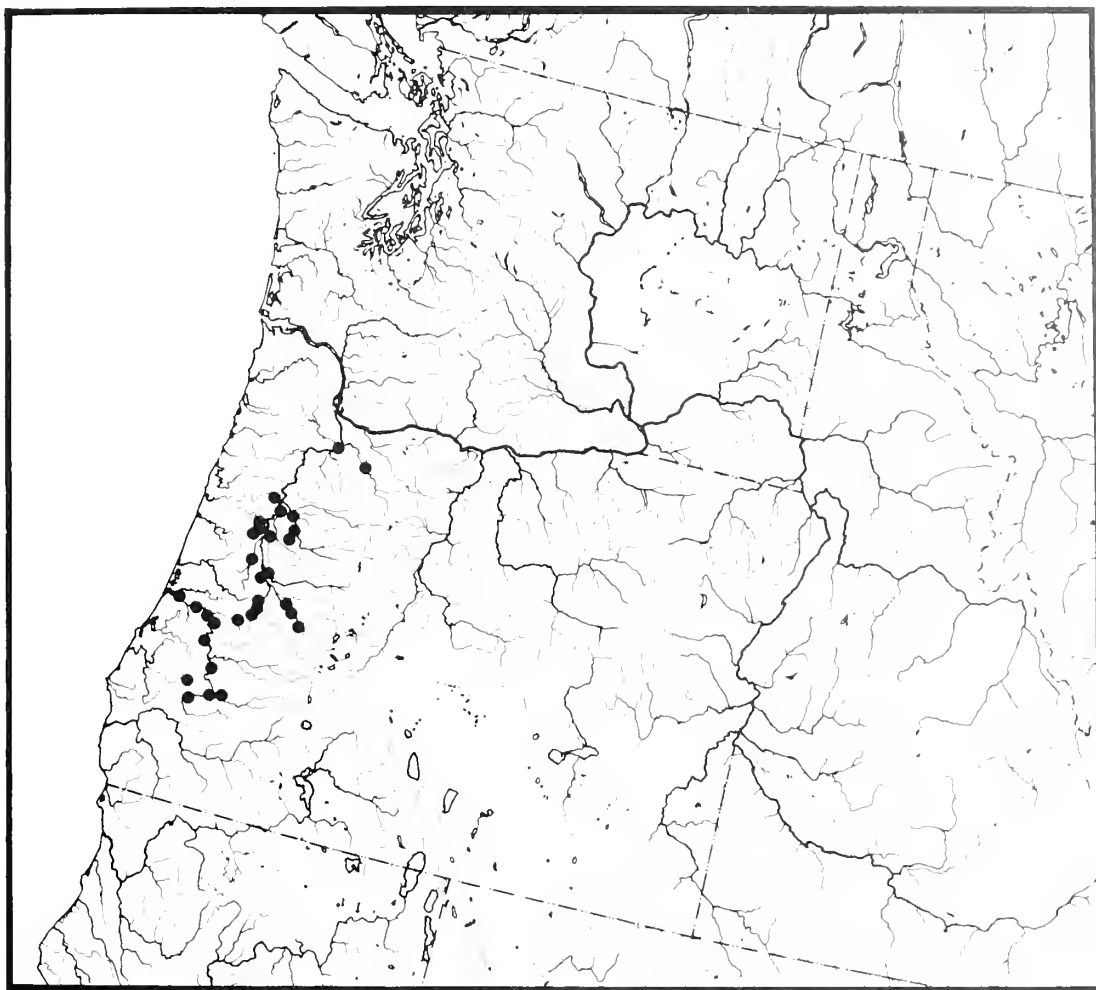
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Willamette River at Oregon City, OR (Snyder 1908. Bull. Bur. Fish. 27:153-89).



(Bond 1973. *Key to the Fishes of Oregon*).

SYSTEMATICS: Hubbs (*in* Schultz 1929. Publ. Fish. Univ. Wash. 2:43-50; see Schultz and Hubbs 1961. Copeia:477-78) regarded *Oregonichthys* as subgenus of polytypic *Hybopsis*, warranting recognition at generic level (Hubbs et al. 1974. Mem. Cal. Acad. Sci. 7:1-259, and references therein). Study of Willamette and Umpqua populations may indicate subspecific recognition.



DISTRIBUTION AND HABITAT: Only in Willamette River system of Columbia drainage and Umpqua River drainage of western OR. Once widespread in Willamette system, but currently very localized. Preferred habitat in Willamette is slow-moving pools, backwaters, ponds, and reservoirs; often associated with aquatic vegetation. More common in Umpqua drainage and often in areas of considerable current (Bond 1974. Agri. Exp. Sta. Oregon State Univ. Spec. Rep. 205:7).

ADULT SIZE: 30-50 mm SL.

BIOLOGY: Little known. Appears to spawn in early spring in still water. Only published work dealing with biology (Davis and Miller 1967. Copeia:1-39) classified species as obligatory sight-feeder on basis of anatomy. Field observations appear to support this conclusion.

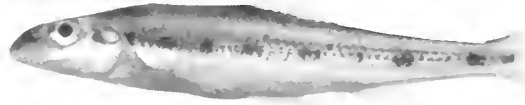
Compiler: J. J. Long. August 1978.

Hybopsis dissimilis (Kirtland)
Streamline chub

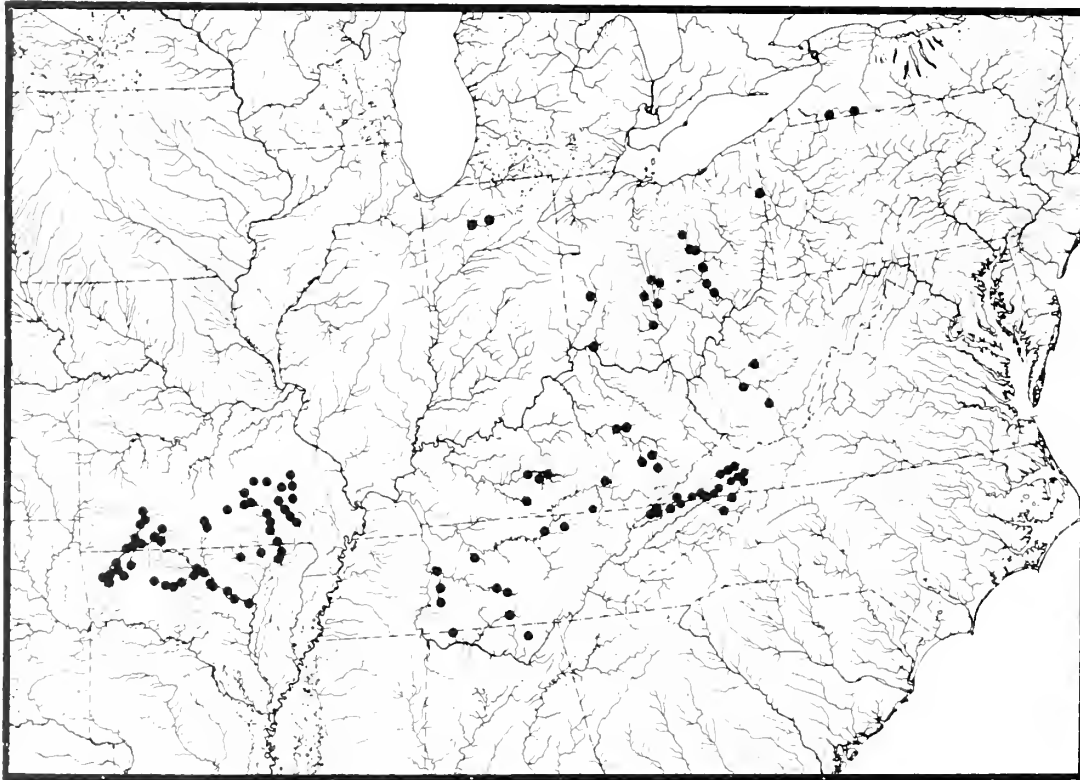
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Presumably Mahoning River near Youngstown, OH (Kirtland 1841. Boston J. Nat. Hist. [1840]: 338-52; also see Trautman 1957. *The Fishes of Ohio*)

SYSTEMATICS: Subgenus *Erimystax*. Closest affinities with *H. insignis* and *H. x-punctata*. Hubbs and Crowe (1956. Occas. Pap. Mus. Zool. Univ. Mich. 578:1-8) recognized two subspecies, *H. d. dissimilis* and *H. d. harryi*.



VA: Smyth Co., Holston River system, 80 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Nominate subspecies distributed east of Mississippi River in Ohio River basin from AL and TN north to NY. Apparently occurred before 1900 in Lake Erie drainage of northern OH, although no specimens extant (Trautman 1957). *Hybopsis d. harryi* found west of Mississippi River in White, Black, and St. Francis drainages of AR and MO. Typically inhabits large, medium-gradient, moderately clear streams and rivers with clean gravel substrate. Appears to prefer shoal areas with moderate flow.

ADULT SIZE: 60-115 mm SL.

BIOLOGY: Spawning occurs mid-May to mid-June. Fecundity average 400 for Duck River population; nothing else known of spawning behavior. Davis and Miller (1967. Copeia: 1-39) suggested *H. dissimilis* is primarily a sight feeder based on reduced concentration of cutaneous taste buds and brain morphology. Feeding observations of substrate pecking substantiates this hypothesis. Appears opportunistic, feeding on wide variety of benthic organisms (primarily insect larvae and gastropods) and occasional terrestrial insects.

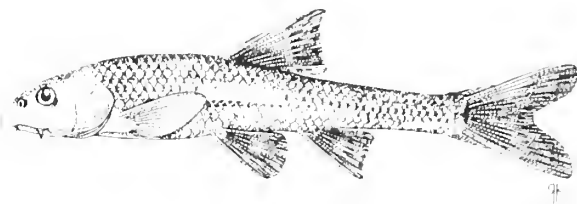
Compiler: J. L. Harris. May 1979.

Hybopsis gelida (Girard)
Sturgeon chub

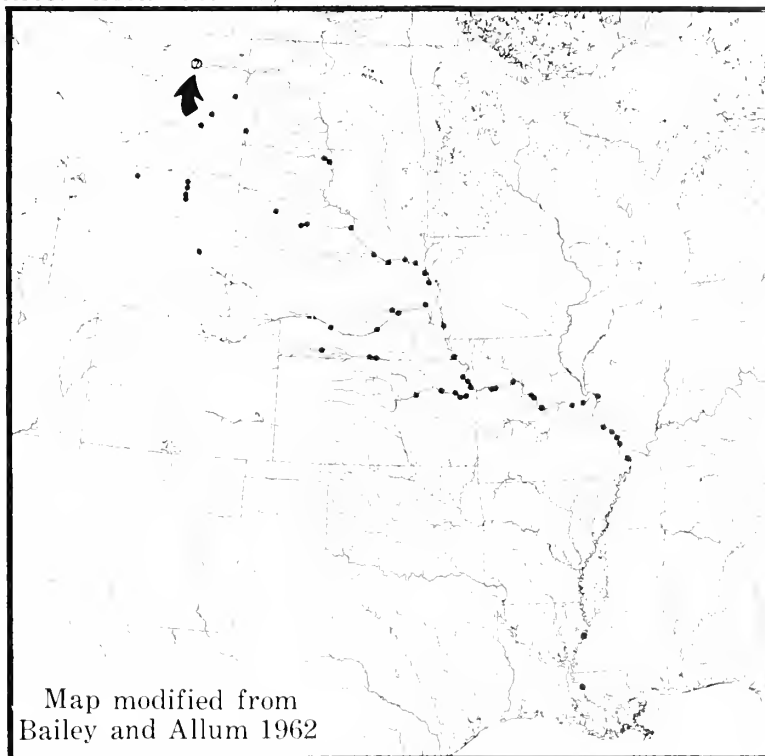
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Milk River, tributary of upper Missouri River (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213). Exact locality unknown, plotted at Milk River mouth, MT; Brown (1971. *Fishes of Montana*) noted that species not known from Milk system since early times.

SYSTEMATICS: Subgenus *Macrhybopsis*, with *H. meeki*. Nomenclatural review by Reno (1969. Proc. Okla. Acad. Sci. 48:65-71). Probably most closely related to *H. aestivalis*, *H. storeriana*, *Platygobio gracilis*, the subgenus *Erimystax* of *Hybopsis*, and genus *Phenacobius* (in part Jenkins and Lachner 1971. Smithson. Contrib. Zool. 90:1-15).



MT: Custer Co., Tongue River,
38 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Missouri River basin from MT and WY, where only in Missouri River and western tributaries draining the Plains; middle Mississippi River between mouths of Missouri and Ohio rivers, and lower Mississippi River near Grand Gulf, MS, and just above Baton Rouge, LA (Conner and Guillory 1974. ASB Bull. 21:48; Conner in litt.). Inhabits continuously and heavily turbid, warm, medium-sized to big rivers, where found in shallow areas of strong current with sand and, perhaps more frequently, gravel bottom. Distribution spotty. Probably extirpated from MT, rare in WY and MO, common in middle part of Missouri River (in part Bailey and Allum 1962. *Fishes of South Dakota*). Decline in upper Missouri direct effect of impoundments and possibly due to decreased turbidity below dams.

ADULT SIZE: 50-70 mm SL.

BIOLOGY: Probably spawns late spring to midsummer; tuberculate males taken in May (water 23°C) in KS and late June in WY, and nontuberculate specimens in July and August in KS (Cross 1967. *Handbook of Fishes of Kansas*); gravid females and tuberculate males taken 14 July in SD. Attain ca. 28-29 mm TL at end of first summer (Pflieger 1975. *The Fishes of Missouri*). Presumably a benthic taste feeder. Highly specialized for swift, turbid water; hydrodynamic features and sensory modalities treated by Moore (1950. Trans. Am. Microscop. Soc. 69:69-95), Branson (1963. J. Morphol. 113:215-30; 1966. Copeia:872-76), Davis and Miller (1967. Copeia:1-39), and Reno (1969. Copeia:736-73).

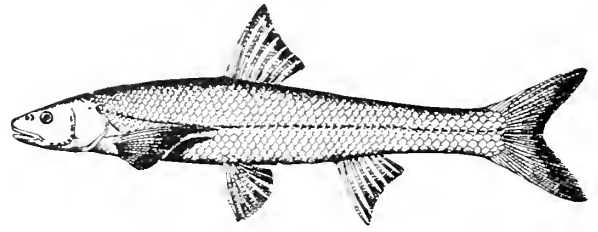
Compiler: R. E. Jenkins. June 1979.

Hybopsis gracilis (Richardson)
Flathead chub

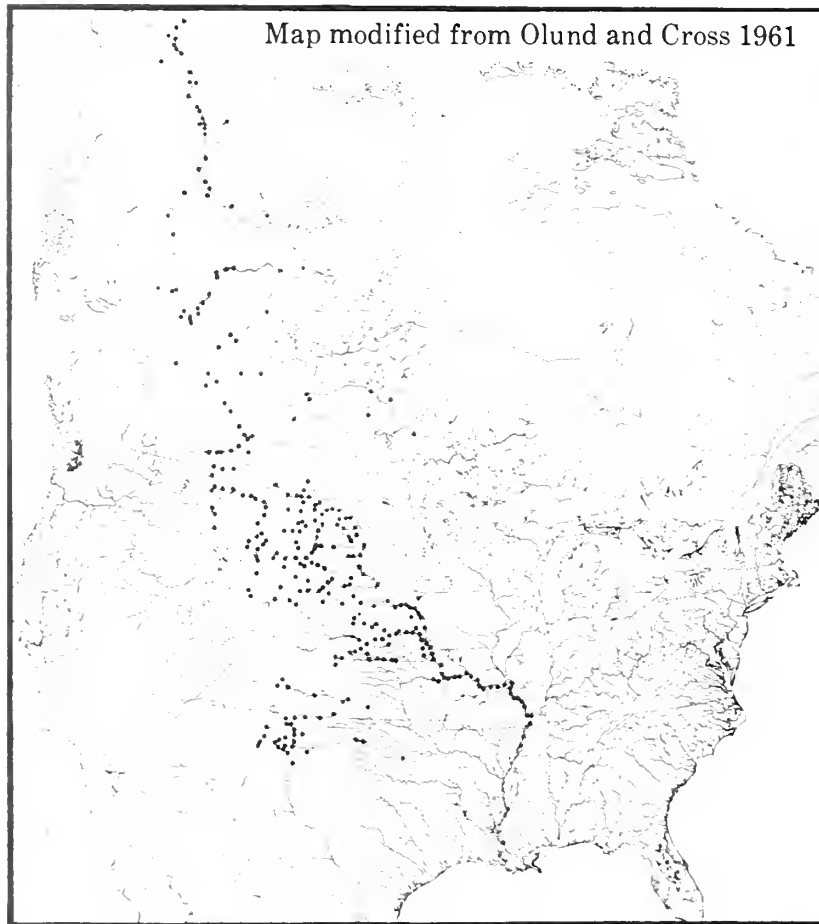
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Saskatchewan River, (Carleton House), Canada (Richardson 1836. *Fauna Boreali-Americana*).

SYSTEMATICS: Genus *Platygobio* placed in genus *Hybopsis* by Bailey (in Harlan and Speaker 1951. *Iowa Fish and Fishing*:187-237) but re-elevated by McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*). Listed in 1980 AFS checklist as *Hybopsis*. Geographic variation studied by Olund and Cross (1961. Univ. Kans. Mus. Nat. Hist. Publ. 13:323-48) who concluded that differences were best expressed by recognition of *H. g. gracilis* and *H. g. gulonella* as subspecies.



SD: White River (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: West-central North America from lower Mississippi River and tributaries of South Canadian River in OK to Rio Grande in NM. In Canada north to Lake Winnipeg and Saskatchewan and Mackenzie river drainages. In turbid, flowing waters in main channels of large rivers (Olund and Cross 1961), but also reported from shallow to fairly deep water over mud or rocky bottoms (Brown 1971. *Fishes of Montana*). Abundant in Missouri and mid-Mississippi rivers.

ADULT SIZE: 95-190 mm TL, 317 mm TL maximum.

BIOLOGY: Little known. Olund and Cross (1961) reported diet primarily of terrestrial insects, supplemented by lesser quantities of small invertebrates. Sexual maturity obtained at approximately 85 mm SL with spawning occurring during mid or late summer.

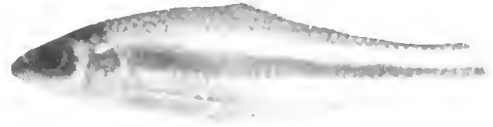
Compiler: S. T. Kucas. July 1978.

Hybopsis hypsinotus (Cope)
Highback chub

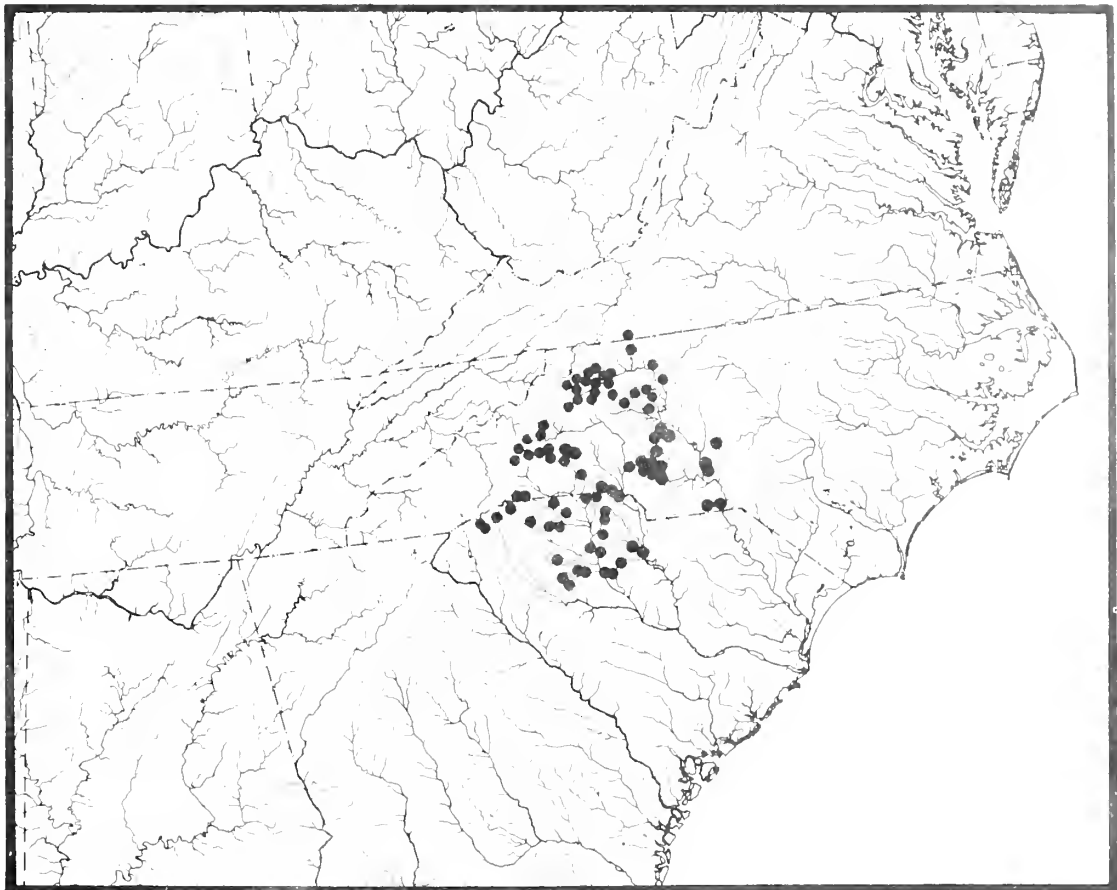
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributary of Yadkin River, Roane [=Rowan] Co., NC (Cope 1870. Proc. Am. Philos. Soc. 11:448-95). Type locality restricted by lectotype designation of Jenkins and Lachner (in Gilbert 1978. Bull. Fla. State Mus. Bio. Sci. 23:1-104).

SYSTEMATICS: Currently in subgenus *Hybopsis* (Reno 1969. Copeia:736-73; Jenkins and Lachner 1971. Smithson. Contrib. Zool. 90:1-15), but relationships uncertain. Jenkins and Lachner are studying variation and relationships.



NC: Montgomery Co., Cheek Creek, 51 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Widely distributed in Blue Ridge foothills and typical Piedmont sections of Peedee and Santee drainages, VA, NC, and SC. Occupies small streams to medium-sized rivers with sandy and rocky bottoms and clear to turbid, warm waters. Rare to common; generally taken in small numbers.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Sexually dimorphic and dichromatic. Apparently spawns in late spring and early summer, based on condition of preserved adults.

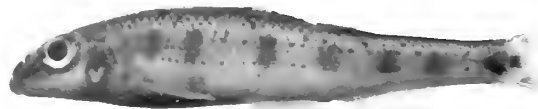
Compilers: R. E. Jenkins and E. A. Lachner.
July 1978.

Hybopsis insignis Hubbs and Crowe
Blotched chub

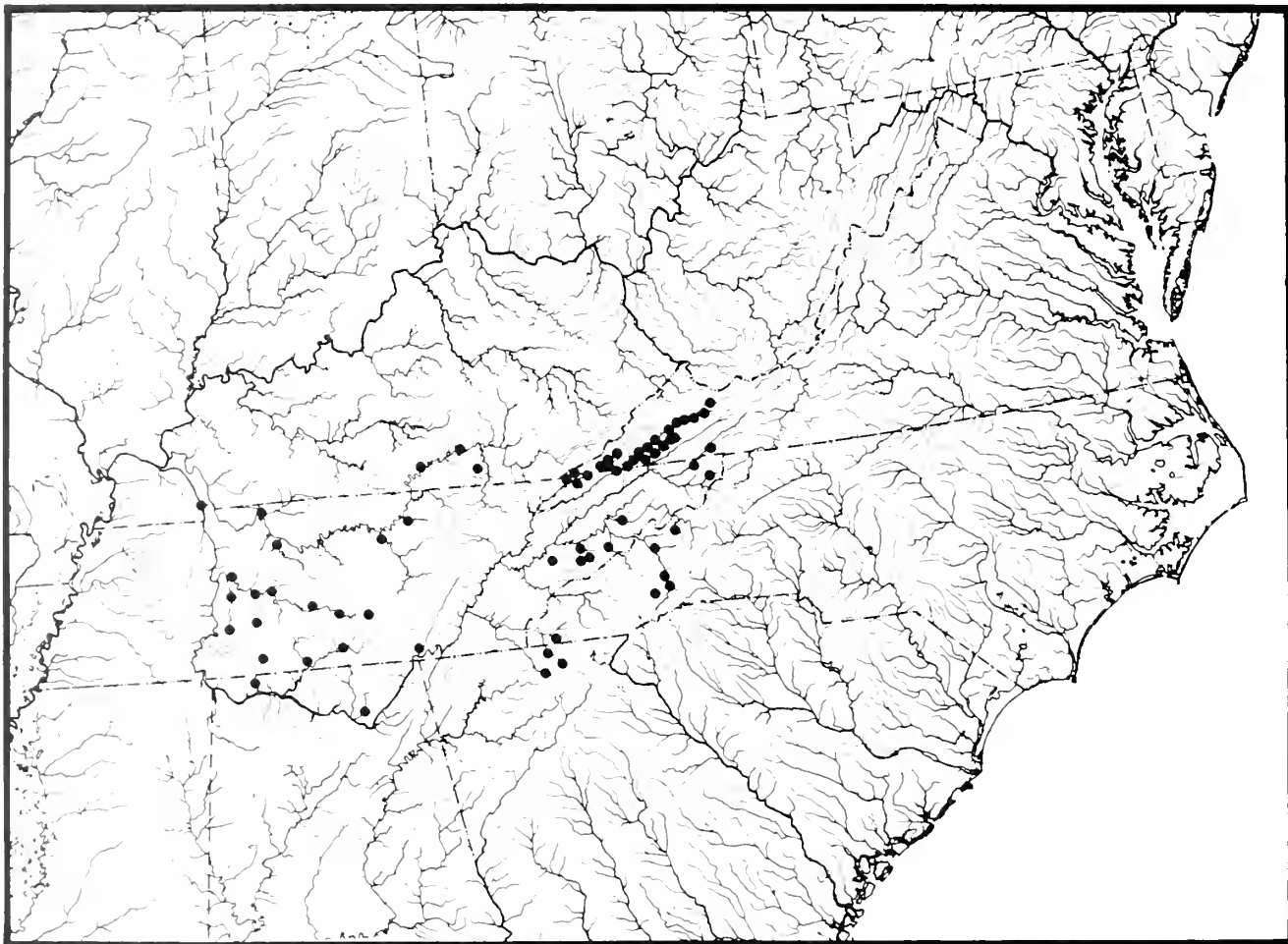
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tennessee River at head of Blood River Island, Calloway Co., KY (Hubbs and Crowe 1956, Occas. Pap. Mus. Zool. Univ. Mich. 578:1-8).

SYSTEMATICS: Subgenus *Erimystax*. Closely related to *H. dissimilis*. Two subspecies recognized, *H. i. insignis* and *H. i. cristigma* (Hubbs and Crowe 1956).



TN: Sevier Co., French Broad River system, 57 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Nominate subspecies distributed in Cumberland River drainage in KY and TN and lower Tennessee River drainage as far upstream as Sequatchie River in TN. *Hybopsis i. cristigma* in upper Tennessee River drainage in TN, GA, NC, and VA. Specimens from Clinch and Powell rivers in TN and VA regarded as intergrades (Hubbs and Crowe 1956). Typically inhabits medium to large size, clear, medium to high gradient, warm streams with clean gravel or rock substrate. Generally uncommon, sometimes locally common.

ADULT SIZE: 45-77 mm SL.

BIOLOGY: Spawns late spring to early summer. Nothing else known of spawning behavior. Davis and Miller (1967, Copeia:1-39) and Reno (1969, Copeia: 736-73) suggested use of olfaction for food detection and discrimination and feeding by groping about riffle bottom instead of relying on visual acuity, as do other *Erimystax*. Recent observations of *H. insignis* "gleaning" substrate support this hypothesis. Stomach analysis of specimens from Duck River, TN, show filamentous algae and wide variety of benthic invertebrates dominated by the ephemeropteran *Potamanthus*.

Compiler: J. L. Harris. January 1979.

***Hybopsis labrosa* (Cope)**
Thicklip chub

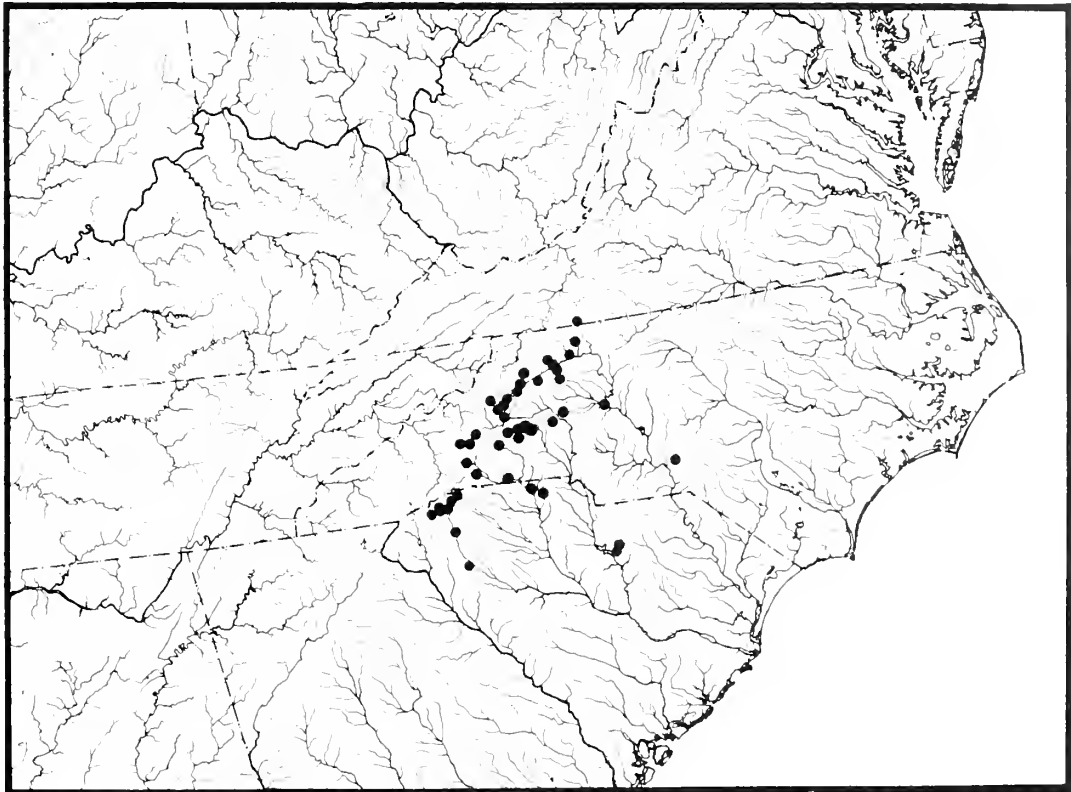
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Upper waters of Catawba River, McDowell and Burke cos., NC (Cope 1870. Proc. Am. Philos. Soc. 11:448-95).

SYSTEMATICS: Currently in subgenus *Hybopsis* (Reno 1969. Copeia:736-73). This species, *H. zanema*, and the undescribed Thinlip chub form a species group having close affinity with the subgenus *Cyprinella*, genus *Notropis* (in part, Jenkins and Lachner 1971. Smithson. Contrib. Zool. 90:1-15). Originally described by Cope (1870) from composite of Thicklip and Santee chubs, but the name *labrosa* restricted of Thicklip chub by lectotype designation of Jenkins and Lachner (in Gilbert 1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104). Called *Hybopsis* sp., cf. *labrosa*, by Jenkins and Lachner (1971), who applied the name *labrosa* to only the Santee chub, now called *H. zanema*.



NC: Burke Co., Johns River,
48 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Blue Ridge foothill and typical Piedmont sections of Pee Dee and Santee drainages, VA, NC, and SC. Inhabits small to large streams with sandy and rocky bottoms and clear to turbid, warm waters. Rare to common; generally collected in small numbers. Most common in upper Piedmont. Often syntopic in Santee with *H. zanema*.

ADULT SIZE: 40-55 mm SL.

BIOLOGY: Sexually dimorphic and dichromatic. Probably spawns in early summer, based on condition of preserved adults.

Compilers: R. E. Jenkins and E. A. Lachner.
July 1978.

Hybopsis lineapunctata Clemmer
and Suttkus
Lined chub

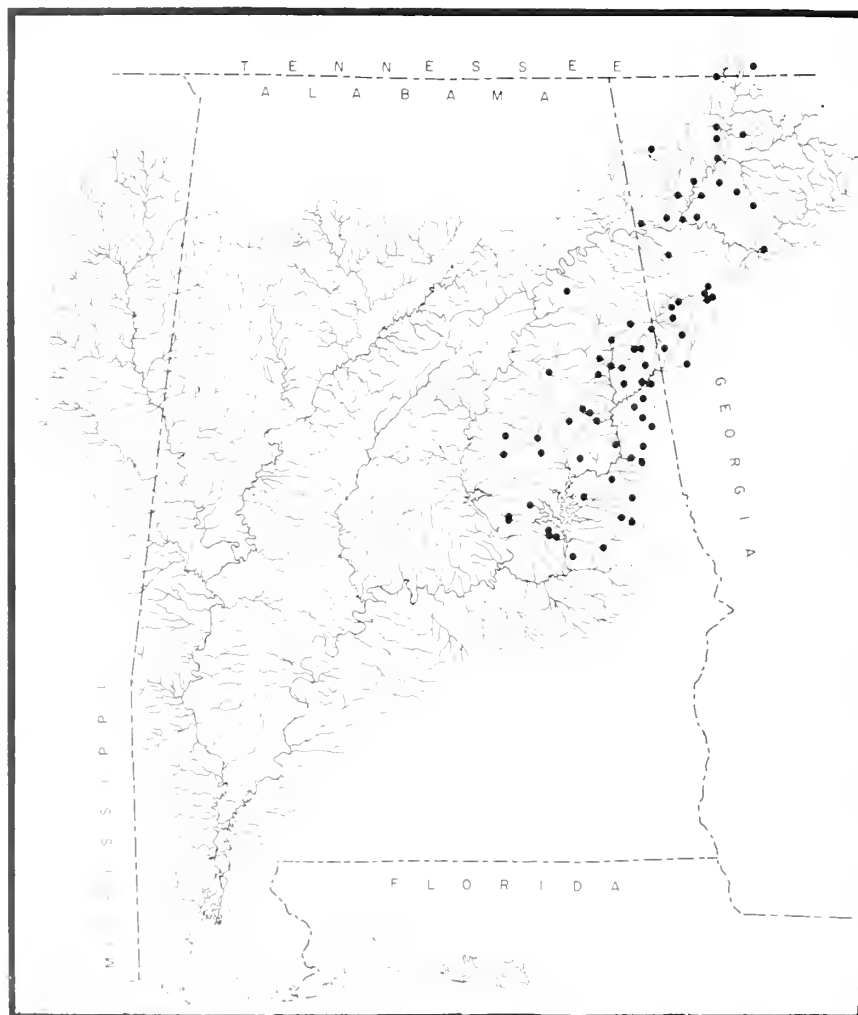
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Enitachope Creek, tributary to Hillabee Creek (Tallapoosa River system), 4.7 km sw of Ashland, at hwy. 9, Clay Co., AL (Clemmer and Suttkus 1971. Tulane Stud. Zool. Bot. 17:21-30).

SYSTEMATICS: Subgenus *Hybopsis*. Clemmer (1971. Ph.D. diss., Tulane Univ.) reviewed systematics. Apparently most closely related to *H. amblops*; other close relatives include *H. rubrifrons*, *H. winchelli*, and *Notropis amnis*. Although obviously closely related, *N. amnis* is provisionally retained in *Notropis* because it lacks barbels at corners of mouth.



GA: Haralson Co., Tallapoosa River, 56 mm SL (NCSM).



Map modified from Clemmer and Suttkus 1971

DISTRIBUTION AND HABITAT: Endemic to Tallapoosa and Coosa River systems (Mobile Bay drainage) above Fall Line in AL, GA, and TN. Moderately common in small to moderate-sized streams in slightly flowing to quiet, often clear water near riffles.

ADULT SIZE: 66 mm SL maximum.

BIOLOGY: No information on food, age or behavior. Clemmer and Suttkus (1971) reported tuberculate males with enlarged testes and females with mature ova from mid-March to early June. Post-spawning adults collected as early as 23 May.

Compiler: C. R. Gilbert. August 1978.

Hybopsis meeki Jordan and Evermann
Sicklefin chub

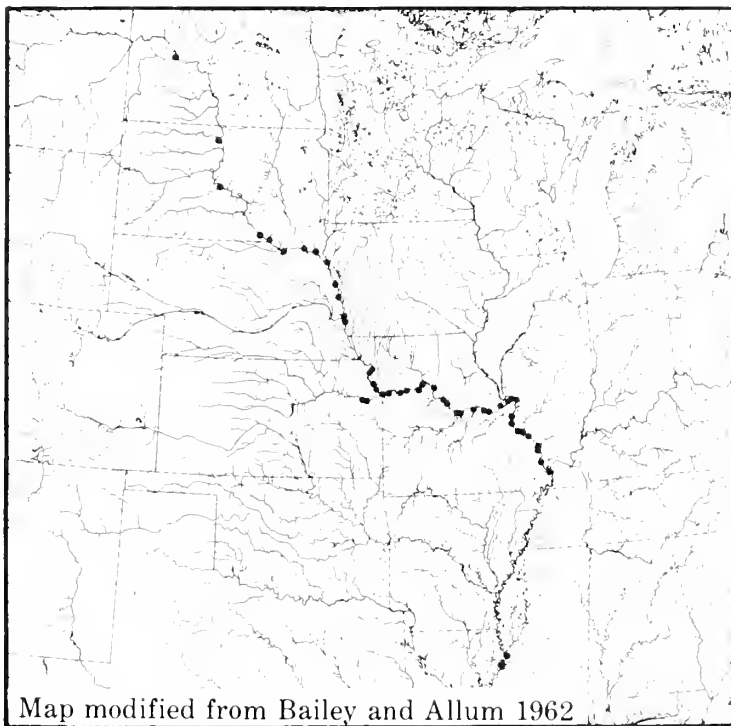
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Missouri River at St. Joseph, MO, "and elsewhere, in the river channel" (Jordan and Evermann 1896. U.S. Natl. Mus. Bull. 47:1-1240).

SYSTEMATICS: Subgenus *Macrhybopsis*, with *H. gelida*. Nomenclature reviewed by Reno (1969a. Proc. Okla. Acad. Sci. 48:65-71). Hubbs and Ortenburger (1929. Publ. Univ. Okla. Biol. Surv. 1:17-43) suggested *H. meeki* generically distinct from *H. gelida*; Reno (1969b. Copeia: 736-73) noted that similarities may be more result of convergent evolution than close phylogenetic kinship. Both species here regarded as closely related to each other and to *H. aestivalis*, *H. storeriana*, *Platygobio gracilis*, the subgenus *Erimystar* of *Hybopsis*, and genus *Phenacobius* (in part Jenkins and Lachner 1971. Smithson. Contrib. Zool. 90:1-15).



MO: Boone Co., Missouri River
at Rocheport (Mo. Dept. Cons.).



Map modified from Bailey and Allum 1962

DISTRIBUTION AND HABITAT: Missouri River, ND. to its mouth, middle Mississippi River from latter to Ohio River mouth, and, in lower Mississippi River (Conner and Guillory 1974. ASB Bull. 21:48; Conner in lit.), near Vicksburg and Grand Gulf, MS. More restricted to largest rivers than *H. gelida*; the only tributary records are in lower Kansas River, KS (Cross 1967. *Handbook of Fishes of Kansas*). Habitat continuously and heavily turbid, warm waters. Taken in shallows in strong current over fine gravel and, perhaps more typically, sand. Common, at least formerly, in and along MO (Bailey and Allum 1962. Misc. Publ. Mus. Zool. Univ. Mich. 119:1-131); still more common there now than *H. gelida* (Pflieger

1975. *The Fishes of Missouri*). May decline in middle Missouri River from decrease in turbidity due to impoundment of upper Missouri (Bailey and Allum 1962).

ADULT SIZE: 50-90 mm SL.

BIOLOGY: Young from Missouri River in July suggest spawning in spring (Pflieger 1975). Presumably benthic taste feeder. Possibly more highly specialized for turbid conditions than *H. gelida*, based on average differences in distribution, habitat, abundance, and trophic-sensory morphology (Moore 1950. Trans. Am. Microscop. Soc. 69:69-95; Davis and Miller 1967. Copeia:1-39; Reno 1969b).

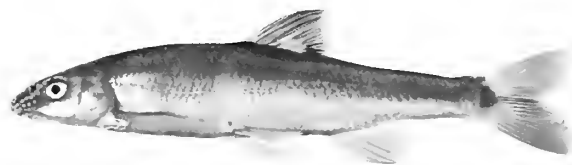
Compiler: R. E. Jenkins. June 1979.

Hybopsis monacha (Cope)
Spotfin chub

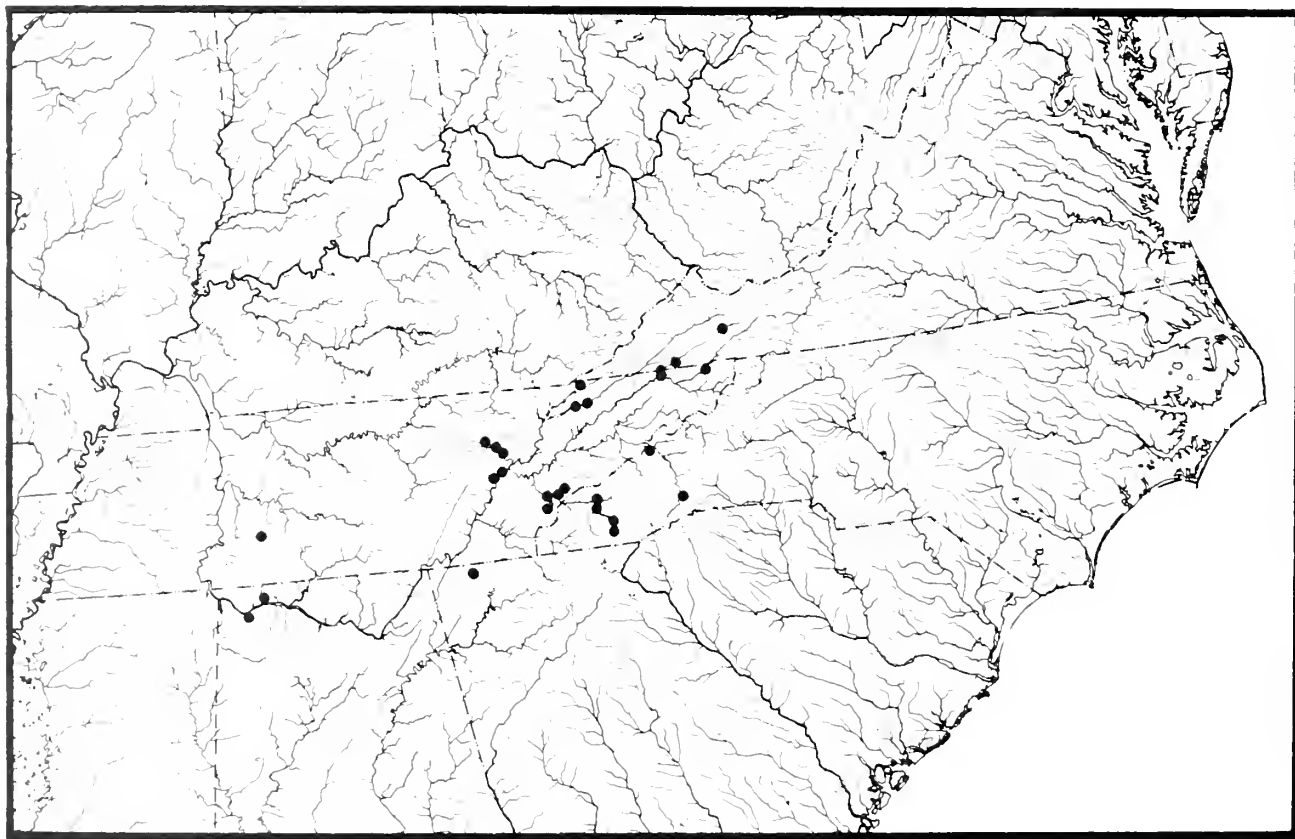
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: North Fork Holston River, vicinity of Saltville, Washington Co., VA (Cope 1868. J. Acad. Nat. Sci. Phila. [Ser. 2] 6:207-47).

SYSTEMATICS: Currently allocated to subgenus *Erimystax* (Hubbs and Crowe 1956. Occas. Pap. Mus. Zool. Univ. Mich. 578:1-8; Reno 1969. Copeia: 736-73). This highly distinctive species also has close affinities with *H. labrosa* and *H. zanema*, presently in subgenus *Hybopsis* (Jenkins and Lachner 1971. Smithson. Contrib. Zool. 90:1-15). These three species actually appear to be most closely related to members of subgenus *Cyprinella*, genus *Notropis*.



VA: Scott Co., North Fork
Holston River, male, 74 mm
SL (R. E. Jenkins).



DISTRIBUTION AND HABITAT: Endemic to Tennessee River drainage in upland or montane habitats of AL, GA, NC, TN, and VA. Formerly occupied 12 tributary systems of Tennessee River, but now widely extirpated. Known recently from North Fork Holston River, VA, Emory River system, TN, and Little Tennessee River, NC. Inhabits warm, typically clear, medium-sized streams and rivers. Found in varied habitats except over heavily silted or sandy substrate. Usually in or near moderate to swift current. In North Fork Holston prefers large bars and beds of small to medium-sized gravel. Gener-

ally uncommon to rare in North Fork Holston and Little Tennessee rivers, more common in Emory system.

ADULT SIZE: 55-85 mm SL.

BIOLOGY: Food mainly immature aquatic insects, largely chironomids and simuliids; observed feeding diurnally. Life span four years. Matures after first full year following hatching. Gravid females and nuptial males taken in June; spawning possibly starts in late May and extends into July.

Compilers: R. E. Jenkins and N. M. Burkhead. July 1978.

Hybopsis rubrifrons (Jordan)
Rosyface chub

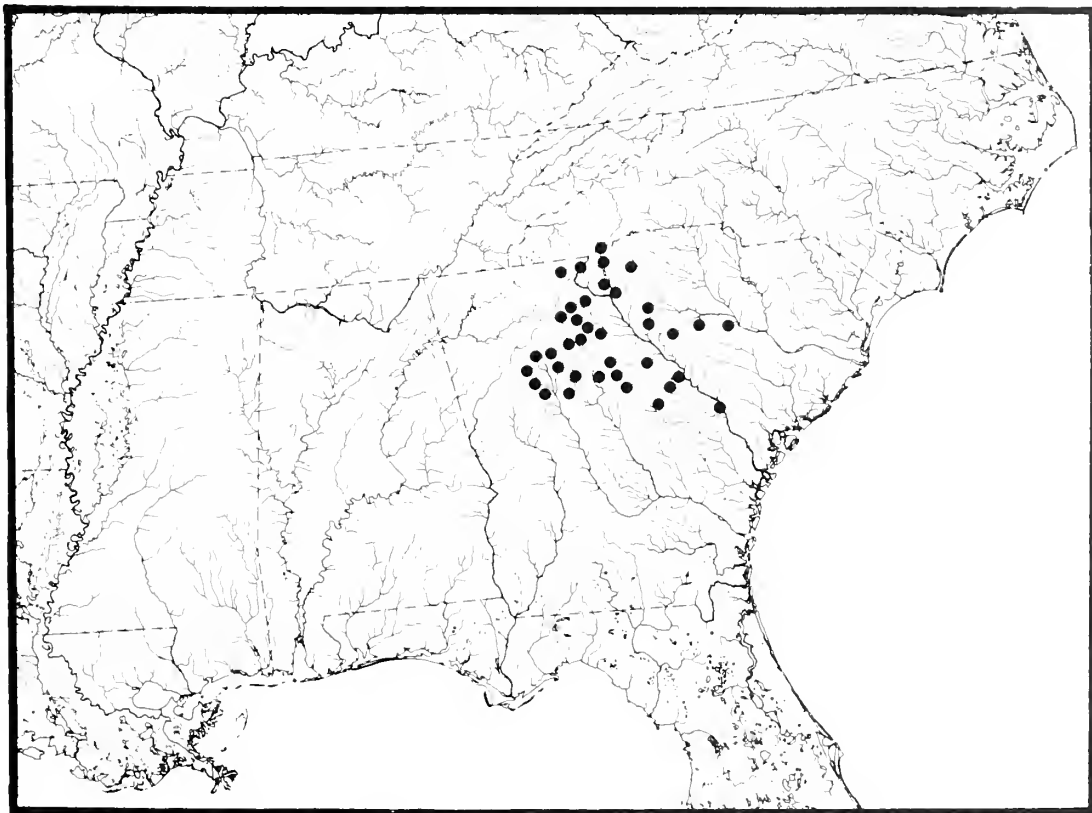
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: South fork of Ocmulgee River, at Flat Rock, DeKalb Co., GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Clemmer (1971. Ph.D. diss., Tulane Univ.) studied systematics of this and closely related species *H. amblops*, *H. lineapunctata*, *H. winchelli*, and *Notropis amnis*.



GA: Oconee Co., Apalachee River, 47 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Headwaters of Altamaha River in GA to Santee River in SC. Also in main stream of Savannah River below Fall Line. Prefers pools or edges of riffles in small streams; usually near banks in eddy currents in larger streams. Generally found over sand or gravel, avoiding regions of heavy siltation. Common.

ADULT SIZE: 70 mm SL maximum.

BIOLOGY: Spawns mid-April through June at 19-23°C, over clean gravel in moderately fast riffles.

Compiler: G. H. Clemmer, October 1979.

Hybopsis storeriana (Kirtland)
Silver chub

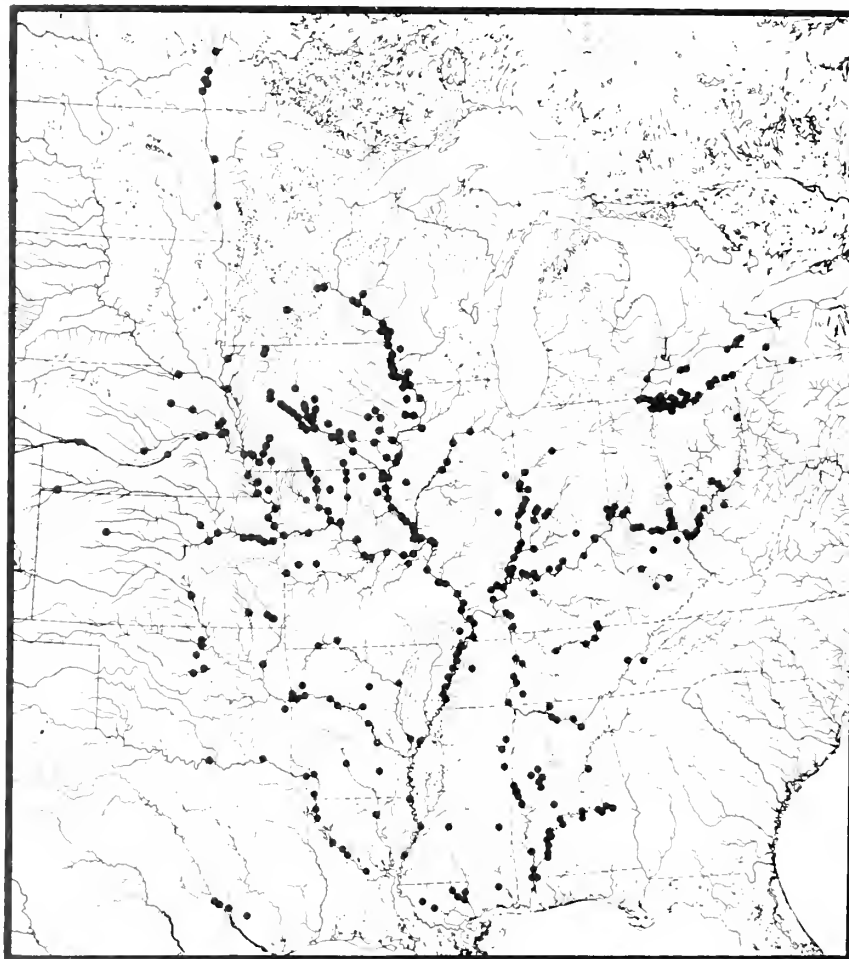
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Ohio River (Kirtland 1844. Proc. Boston Soc. Nat. Hist. [1841-1844] 1:71).

SYSTEMATICS: Trautman (1957. *The Fishes of Ohio*) noted differentiation of Lake Erie population, but no definitive systematic study exists. Jenkins and Lachner (1971. *Smithson. Contrib. Zool.* 90:1-15) discussed relationships of this and other species of barbellated North American cyprinidae.



MO: Boone Co., Missouri River
at Rocheport (Mo. Dept. Cons.).



DISTRIBUTION AND HABITAT: Mobile Bay to Mississippi River basins (including Pearl River and Pascagoula drainage) on Gulf slope, with semi-isolated population present in lower Brazos River drainage, TX. North in Mississippi River basin throughout eastern drainages, but absent from most Great Plains drainages. Extends north into Red River of North drainage, southern MB. In Great Lakes basin confined to Lake Erie and major tributaries. Mainly restricted to large, often silty rivers, where it may be common.

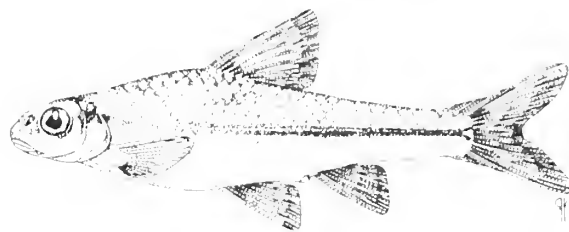
ADULT SIZE: 231 mm TL maximum.

BIOLOGY: Kinney (1954. Ph.D. diss., Ohio State Univ.) provided the most definitive life history study. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) and Scott and Crossman (1973. *Freshwater Fishes of Canada*) summarized biological data. Spawning occurs in late May and June in OH, mostly at temperatures above 21° C, and is thought to occur in open water. Few individuals live longer than three years. Food consists mostly of aquatic insect larvae, cladocerans, and copepods.

Compiler: C. R. Gilbert. August 1978.

Hybopsis winchelli (Girard)
Clear chub

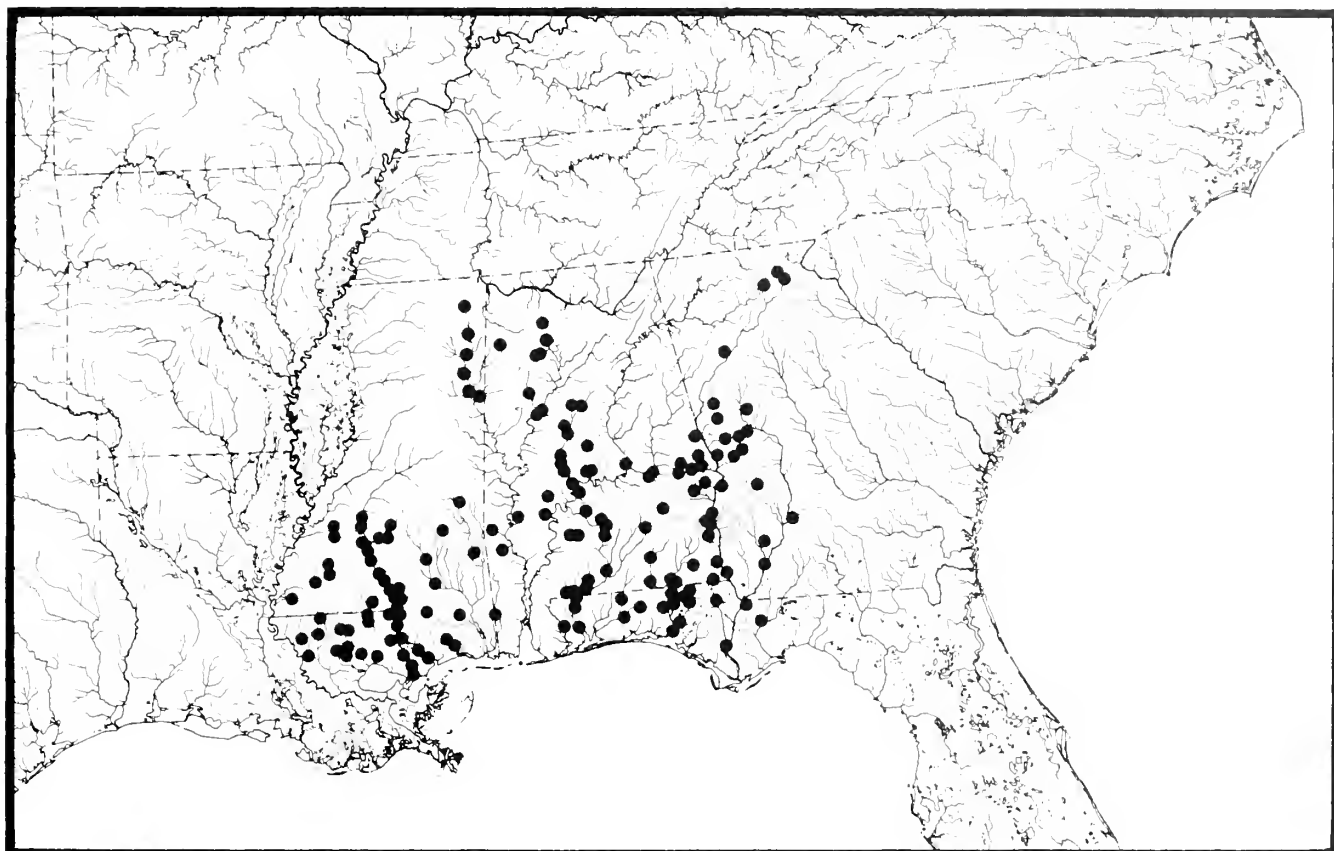
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: Black Warrior River, AL (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Subgenus *Hybopsis*. Clemmer (1971. Ph.D. diss., Tulane Univ.) studied systematics. Most closely related to *H. amblops*, *H. lineapunctata*, *H. rubrifrons*, and particularly *Notropis annis*. Populations east of Mobile Bay basin may be distinct species differing in shape of snout, position of mouth, head length, and especially in size and position of nuptial tubercles.

AL: Escambia Co., Escambia Creek, 53 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Eastern tributaries of Mississippi River in southwestern MS, east along Gulf slope to Ocklocknee River in FL. Generally in major streams and larger tributaries over mixed sand, silt bottoms, usually in pools adjacent to riffle areas. Eastern populations also found in smaller streams.

ADULT SIZE: 70 mm SL maximum.

BIOLOGY: Populations from Mobile Bay west spawn late February to late March at 10-17°C. Populations to east apparently spawn in late spring and early summer.

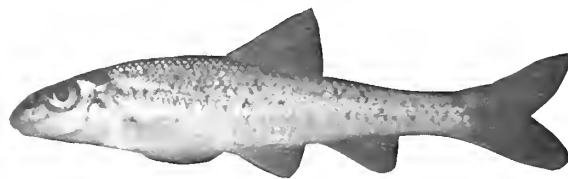
Compiler: G. H. Clemmer. October 1979.

Hybopsis x-punctata Hubbs and
Crowe
Gravel chub

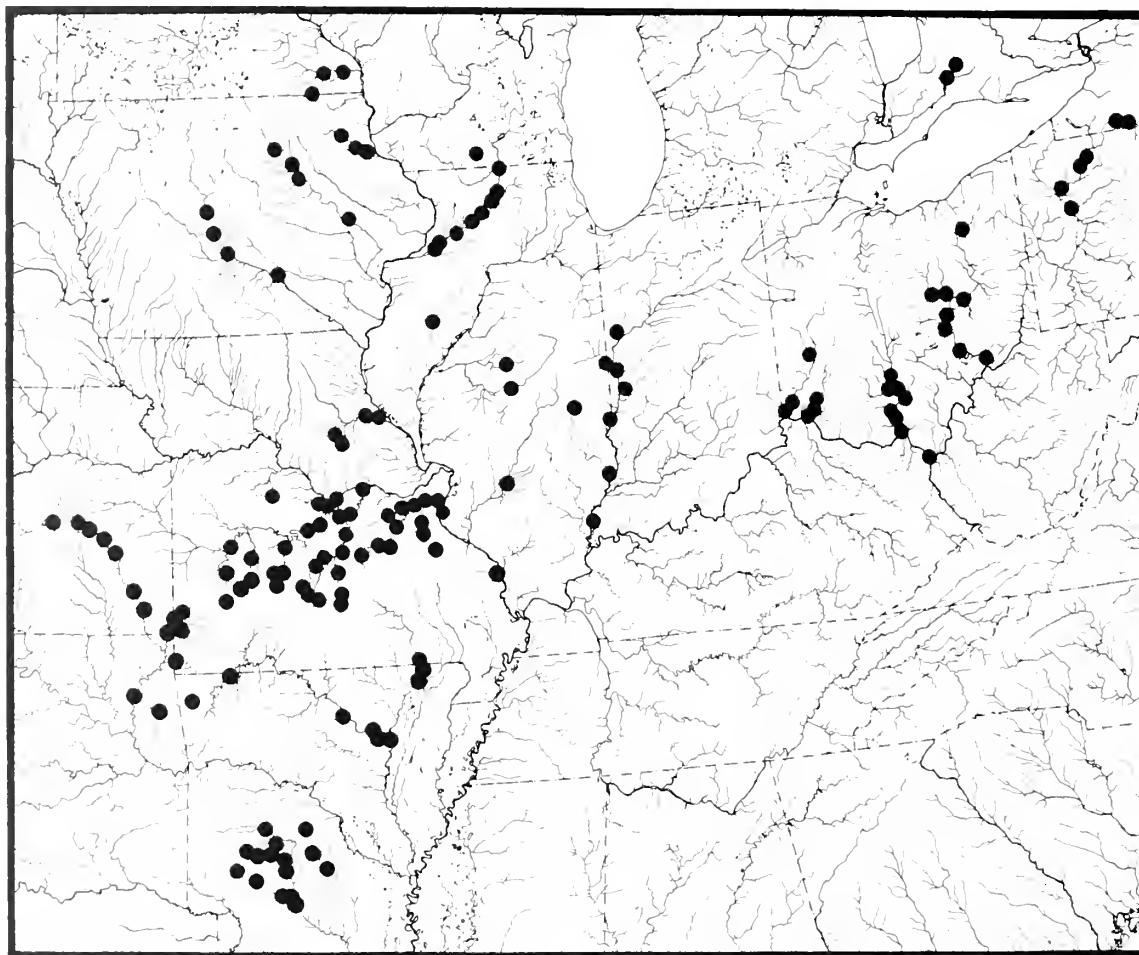
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Gasconade River at Starks Fork, 12.9 km s of Richland, Pulaski Co., MO (Hubbs and Crowe 1956. Occas. Pap. Mus. Zool. Univ. Mich. 578:1-8).

SYSTEMATICS: Two geographically distinct populations of *H. x-punctata* often recognized: typical subspecies, which occurs west of the Mississippi River, and subspecies *H. x-p. trautmani* in east.



MO: Cole Co., Osage River,
52 mm SL (Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: Wide but spotty distribution from south-central AR north to southeastern MN and east to southern ON (Thames River system) and southwestern NY. Apparently absent from areas south of Ohio River. Now extirpated from ON and many other localities where formerly found. Closely restricted to fine gravel (occasionally rocky) substrate, in areas of moderate flow (usually riffles) in clear to moderately turbid waters of large creeks and rivers. Occasionally common in preferred habitat, particularly in western part of range.

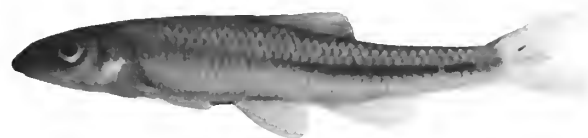
ADULT SIZE: 64-89 mm SL.

BIOLOGY: Very little known. Trautman (1957. *The Fishes of Ohio*) summarized available information.

Compiler: C. R. Gilbert. May 1978.

Hybopsis zanema (Jordan and
Brayton)
Santee chub

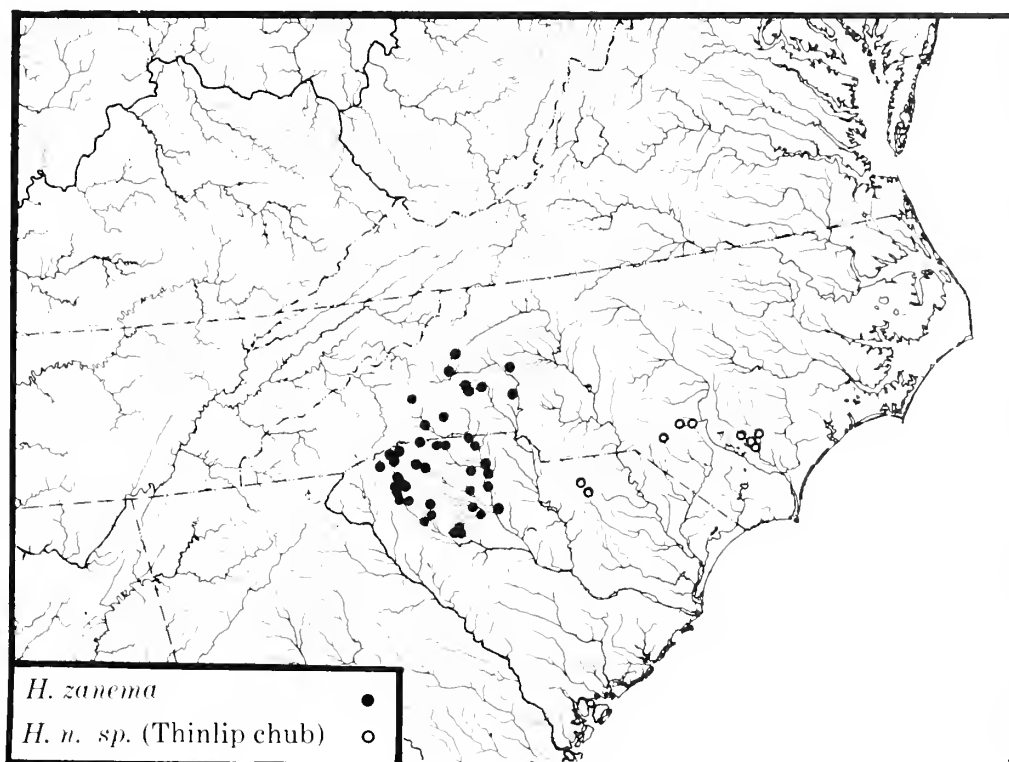
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: Saluda River at Farr's Mills, w of Greenville, Greenville Co., SC (Jordan and Brayton 1878. Bull. U.S. Natl. Mus. 12:1-95).

SYSTEMATICS: Currently in subgenus *Hybopsis* (Reno 1969. Copeia: 736-73). This species, *H. labrosa*, and the undescribed Thinlip chub form a species group having close affinity with the subgenus *Cyprinella*, genus *Notropis* (Jenkins and Lachner 1971. Smithson. Contrib. Zool. 90:1-15). Most closely related to Thinlip chub, whose range in lower Pee Dee and Cape Fear drainages is depicted in this account. *Hybopsis zanema* is resurrected after nearly a century of sy-

NC: Burke Co., Johns River,
55 mm SL (NCSM).



nonymization under *H. labrosa*. Lectotype designated by Jenkins and Lachner (in Gilbert 1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104). Referred to as *H. labrosa* by Jenkins and Lachner (1971) and as *Hybopsis* n. sp. by Menhinick et al. (1974. J. Elisha Mitchell Sci. Soc. 90:24-50).

DISTRIBUTION AND HABITAT: Confined to Blue Ridge foothill and typical Piedmont sections of Santee drainage, NC and SC. Occupies small streams to medium-sized rivers, with sandy and rocky bottoms and clear to turbid, warm waters. Rare to common; generally found in small numbers. Frequently syntopic with *H. labrosa* in upper Santee.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Sexually dimorphic and dichromatic. Probably spawns in early summer, based on condition of preserved adults.

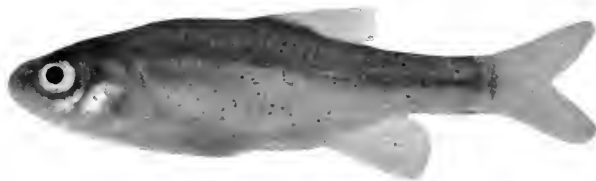
Compilers: R. E. Jenkins and E. A. Lachner.
July 1978.

Lotichthys phlegethontis (Cope)
Least chub

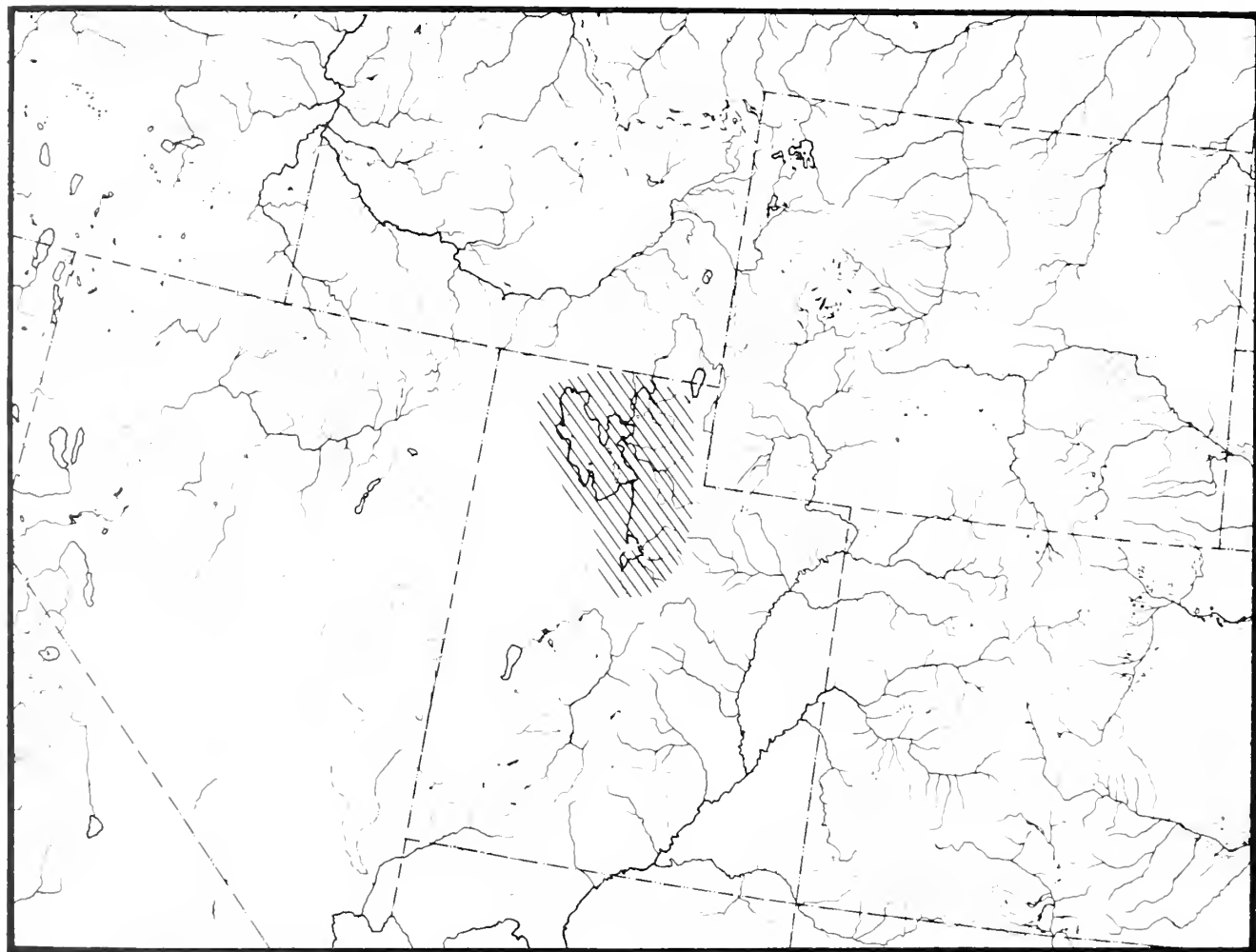
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Beaver River, UT (Cope in Cope and Yarrow 1874. Proc. Am. Philos. Soc. 14: 129-39).

SYSTEMATICS: Generic relationships uncertain. No definitive systematic study published.



UT: Millard Co., Outlet ditch of Big Spring (NCSM).



DISTRIBUTION AND HABITAT: Restricted to Bonneville basin, UT, in streams, freshwater ponds and swamps (occasionally very alkaline) around Great Salt, Sevier, and Utah lakes. Also known from Beaver River, Parowan and Clear creeks, and Provo River (Sigler and Miller 1963. *Fishes of Utah*). Typically in moderate to dense, submergent and emergent, vegetation, with moderate to no (generally slight) current. Found at depths of 10 cm to 91 cm, over bottom consisting of soft clay, muck, mud and peat, where June temperatures vary from 16 to 21 °C (Sigler and Miller 1963).

ADULT SIZE: Normally less than 51 mm TL, 64 mm TL maximum.

BIOLOGY: Males with breeding tubercles in June. Food of young consists largely of microcrustacea; adults prey on larger organisms, such as mosquito larvae, ostracods, and to a lesser degree, *Hyalella* (Sigler and Miller 1963; Carlander 1969. *Handbook of Freshwater Fishery Biology* Vol. 1). Pendleton and Smart (1954 J. Wildl. Manage. 18:226-28) discussed role in mosquito control.

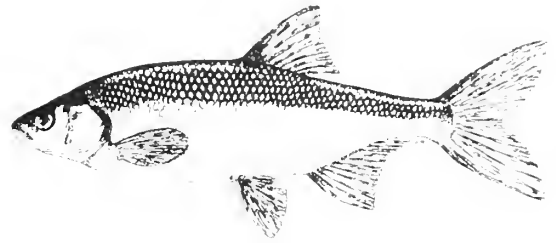
Compilers: S.P. Platania and A.W. Allen.
April 1979.

Lavinia exilicauda Baird and Girard
Hitch

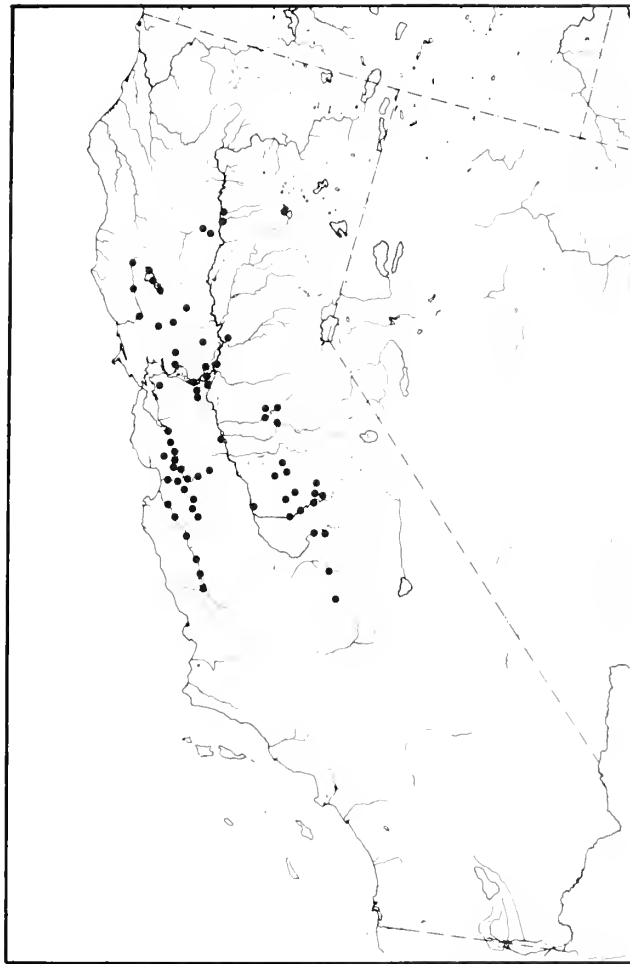
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Sacramento River, CA
(Baird and Girard *in* Girard 1854. Proc.
Acad. Nat. Sci. Phila. [1854-55] 7:129-40).

SYSTEMATICS: Three subspecies have been
recognized: *L. e. chi* from Clear Lake, *L. e.*
exilicauda from Sacramento and San Joa-
quin drainage, and *L. e. havengus* from Pa-
jaro and Salinas drainages (Hopkirk 1973.
Univ. Calif. Publ. Zool. 96:1-135). Hybrid-
izes with *L. symmetricus*, *Orthodon micro-*
lepidotus, and *Gila crassicauda*.



CA: Sacramento-San Joaquin
Delta, 24 cm SL (Moyle
1976).



DISTRIBUTION AND HABITAT: Character-
istic of warm, low elevation lakes, sloughs,
backwaters, and ponds, Sacramento and San
Joaquin rivers; Clear Lake, Lake Co.; and
ponds and slow moving waters of Pajaro
and Salinas rivers. Also abundant in some
reservoirs.

BIOLOGY: Pelagic zooplankton feeder.
Spawns in spring in streams or shallow wa-
ters of lakes. Life history summarized in
Moyle (1976. *Inland Fishes of California*).

ADULT SIZE: 200-300 mm SL.

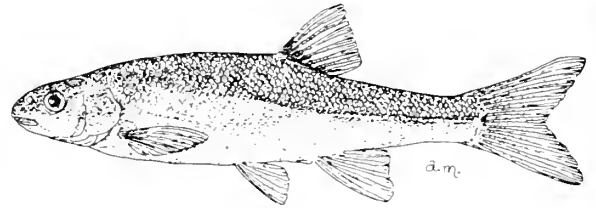
Compiler: P. B. Moyle. July 1978.

Lavinia symmetricus (Baird and Girard)
California roach

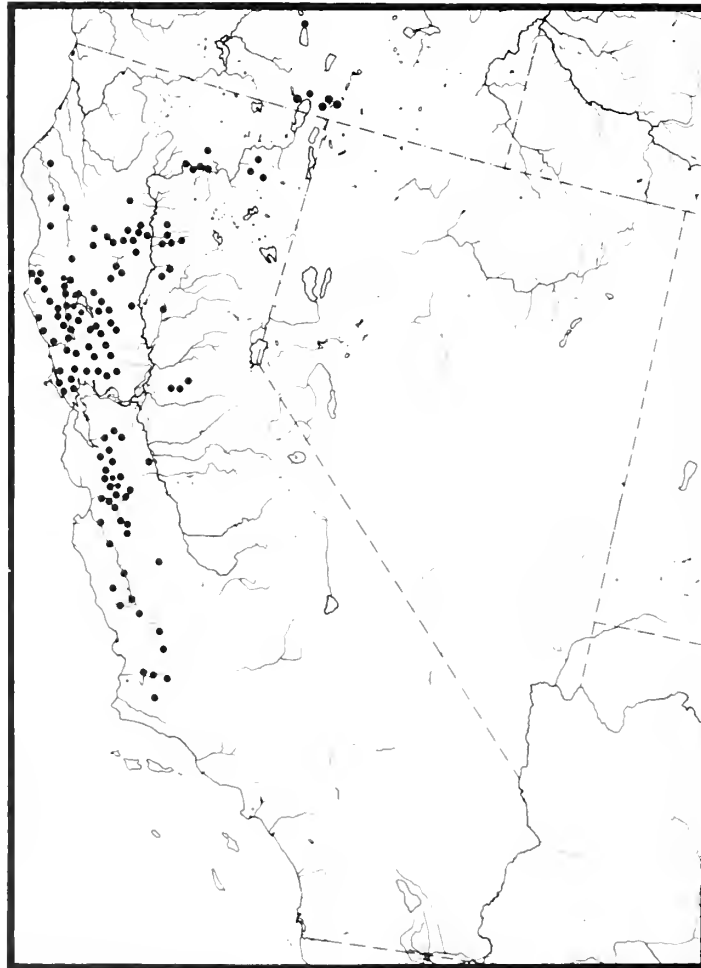
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Fort Miller, San Joaquin River [now Millertown Reservoir], CA (Baird and Girard *in* Girard 1854, Proc. Acad. Nat. Sci. Phila. [1854-55] 7:129-40).

SYSTEMATICS: Previously placed in monotypic genus *Hesperoleucus*, but Avise et al. (1975, Evolution 29:411-26) and Avise and Ayala (1976, Evolution 30:46-58) demonstrated that *L. exilicauda* and this species are congeneric. Snyder (1913, Bull. U.S. Bur. Fish. 32:49-72) described five additional species of *Hesperoleucus*, but these were synonymized with *symmetricus*, apparently on basis of unpublished M.S. thesis of Murphy (1948, Univ. California, Berkeley) which deals with coastal forms only. These are treated as subspecies by Moyle (1976, *Inland Fishes of California*). Known to hybridize with *L. exilicauda* and *Gila oreutti*.



CA: Modoc Co., Rush Creek,
55 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Small streams throughout Sacramento-San Joaquin drainage, including a number of small coastal streams. Also in Cuyama River, San Luis Obispo and Santa Barbara cos., CA.

BIOLOGY: Omnivore capable of surviving under extremely adverse conditions. Life history summarized by Moyle (1976).

ADULT SIZE: 75-90 mm SL.

Compiler: P. B. Moyle, July 1978.

Lepidomeda albivallis Miller and
Hubbs
White River spinedace

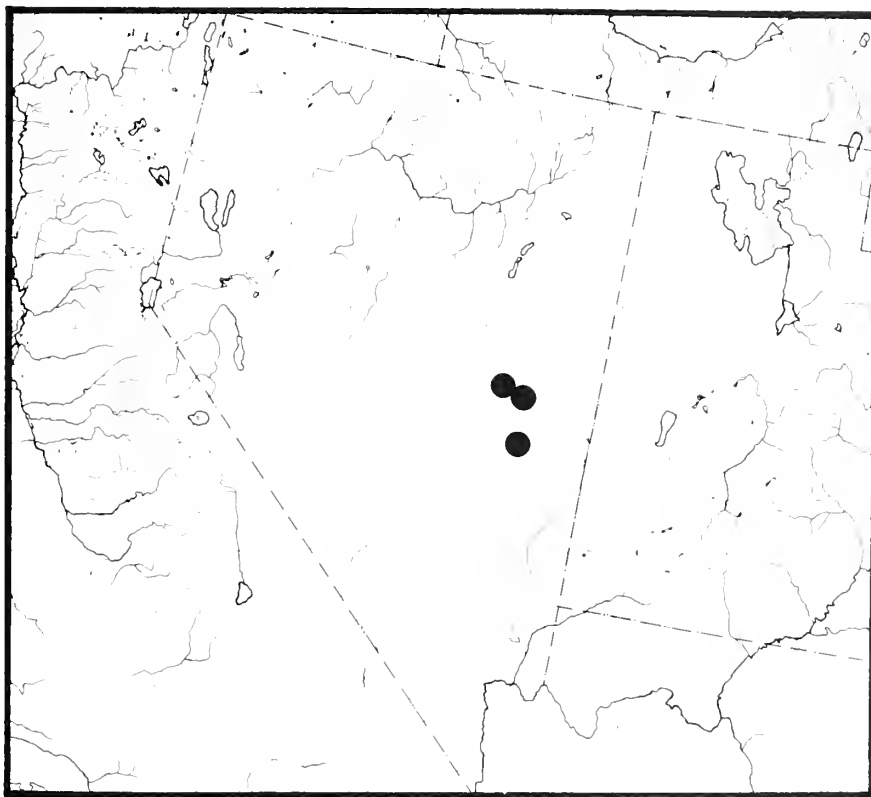
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: White River, just below mouth of Ellison Creek ca. 8 km nw Preston, White Pine Co., NV (Miller and Hubbs 1960. Misc. Publ. Mus. Zool. Univ. Mich. 115: 1-39).

SYSTEMATICS: Referred to as *Lepidomeda* species by several authors (Sumner and Lanham 1942. Biol. Bull. 82:313-27; Miller 1952. Calif. Fish Game 38:7-42; Moore in Blair et al. 1957. *Vertebrates of the United States*). Also identified as *L. vittata* (La Rivers and Trelease 1952. Calif. Fish Game 38:113-23; Eddy 1957. *How to Know the Freshwater Fishes*).



(NCSM)



DISTRIBUTION AND HABITAT: Believed to have evolved in clear, cool waters within Pluvial White River System, NV. Miller and Hubbs (1960) reported occurrence in cool springs (18-22°C), their outflows, and in White River. Largest populations presently are found in Preston Big Spring and Lund Spring, Nye Co., NV. Spring habitat characterized by cool, clear water over sand and gravel bottoms. Miller and Hubbs (1960) reported that surface dimensions of these springs varied from ca. 4.5x7.5m to 18x24.5 m. Appears to prefer shallow areas (0.5-1.5 m deep) in springs. Most common aquatic plants in springs were watercress, pondweed, rushes, and cattails.

ADULT SIZE: 75-120 mm SL, 128 mm SL maximum.

BIOLOGY: Detailed life history studies have not been completed. Review of aspects of life histories of two other species of *Lepidomeda*, *L. mollispinis* (Rinne 1971. M.S. thesis, Univ. Nevada, Las Vegas) and *L. vittata* (Minckley and Carufel 1967. Southwest. Nat. 12:291-302), suggested that ecological requirements are somewhat similar for these species. *Lepidomeda albivallis* also may exhibit similar requirements but further investigations are needed to elucidate its actual life history patterns. It may attain greatest size of the four species. Restriction of this species to springs and a few small outflows makes it highly vulnerable to effects of habitat alteration and introduction of exotic species.

Compiler: W. E. Rinne. November 1978.

Lepidomeda altivelis Miller and
Hubbs
Pahranagat spinedace

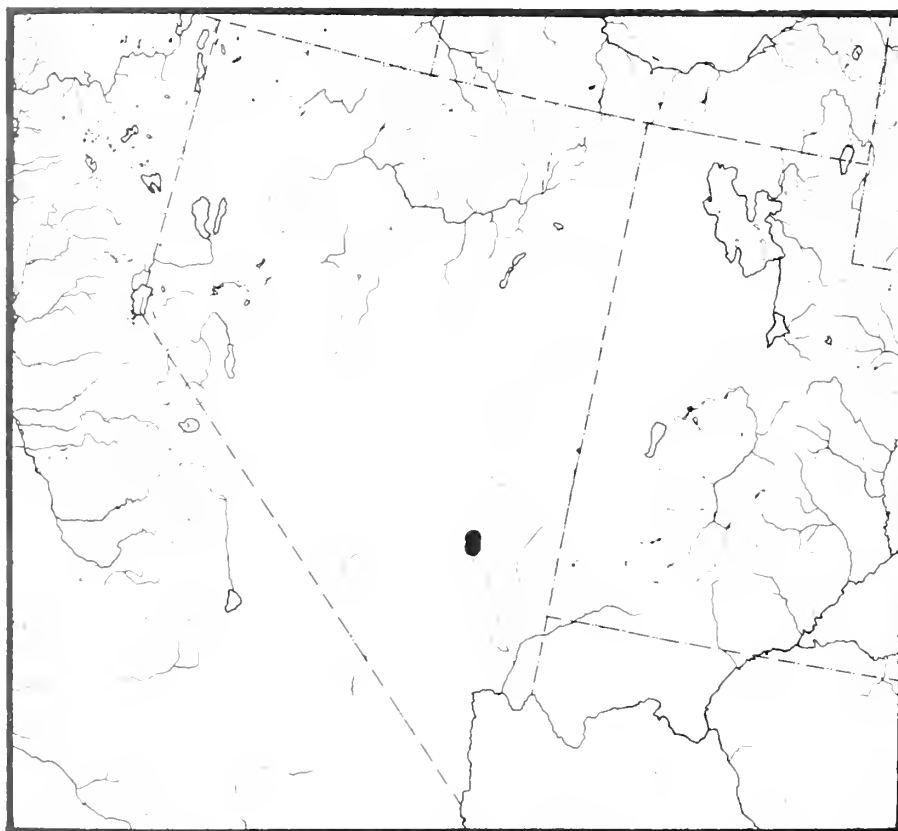
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Outflow of Ash Spring, from 0.4 - 4 km below spring source in Pahranagat Valley, Lincoln Co., NV (Miller and Hubbs 1960. Misc. Publ. Mus. Zool. Univ. Mich. 115:18-24).

SYSTEMATICS: Identified as *L. vittata* and *L. jarrovi* by several authors. External morphology differs from other species of *Lepidomeda* in the extremely oblique mouth, high and expansive dorsal fin, more compressed head and generally finer scales.



Holotype, 56 mm SL (Hubbs and Miller 1960).



DISTRIBUTION AND HABITAT: Historically confined to outflows from springs in middle and lower reaches of Pluvial White River in Pahranagat Valley. Last recorded collections were by Miller and Hubbs, 1938, from outflow of Ash Spring and in upper Pahranagat Lake. These localities are less than 20 km apart and about equal distances above and below Alamo, NV, respectively. Habitat preference was probably for moderately swift, clear spring outflows, but collections made in Pahranagat Lake were in turbid, shallow, lentic waters. Miller and Hubbs failed to find the species in a 1959 re-survey of the area, indicating that it is extinct.

ADULT SIZE: 35 - 66 mm SL.

BIOLOGY: No in-depth studies completed prior to extinction. Too few specimens in museums to further investigate any aspects of life history. Limited extrapolation of ecological requirements of other *Lepidomeda* may be applied to this species. Field collections by Miller and Hubbs (1960) suggested that *L. altivelis* preferred clear, moderately swift spring outflows. Restriction to middle reaches of Pluvial White River apparently maintained its isolation from *L. albigallis* in springs of upper parts of the drainage.

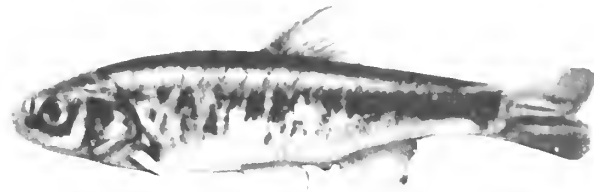
Compiler: W. E. Rinne, November 1978.

Lepidomeda mollispinis Miller
and Hubbs
Virgin spinedace

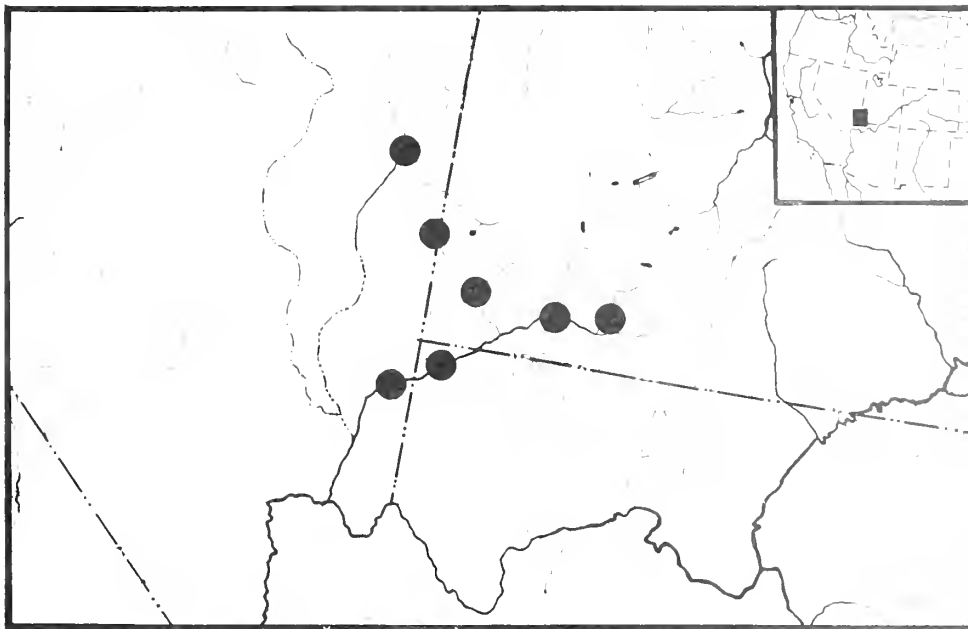
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Santa Clara River, 4.8 km se of Shivwitz and 7.2 km nw of Santa Clara, Washington Co., UT (Miller and Hubbs 1960, Misc. Publ. Mus. Zool. Univ. Mich. 115:1-39).

SYSTEMATICS: Originally referred to as *L. vittata* (Tanner 1932, Copeia:135-36; 1936, Utah Acad. Sci. Arts Lett. 13:155-83). Considered most generalized genus of tribe Plagopterini, with striking resemblance to several species of *Gila* (Miller and Hubbs 1960). Two subspecies, *L. m. mollispinis* and *L. m. pratensis*, recognized; latter believed extinct until 1977 (Deacon, pers. comm).



AZ: Mohave Co., Virgin River
at Littlefield, 87 mm SL
(W. L. Minckley).



DISTRIBUTION AND HABITAT: Virgin River and tributaries in AZ, NV, and UT. Rinne (1971, M.S. thesis, Univ. Nevada, Las Vegas) and Cross (1975, M.S. thesis, Univ. Nevada, Las Vegas) found original distribution relatively intact but populations reduced or extirpated in modified areas. Although found in mainstream, spinedace prefer lower to middle reaches of tributaries. Rinne (1971) found good populations in Santa Clara River, its tributary Magotsu Creek, and sections of North and Ash creeks, UT. Cross (1975) also found substantial populations in these locations except for North Creek, where no spinedace were collected. Santa Clara River and Magotsu Creek support best populations in Virgin River system. Most often associated with clear, cool, relatively swift streams comprised of pools, runs, and riffles. Shaded pools (0.5-2.0 m deep) and runs most often frequented.

ADULT SIZE: 55-90 mm SL, 128 mm SL maximum.

BIOLOGY: Rinne (1971) studied life history. Most spawning from March through early June, some continuing sporadically through July. Mature after one year (age group I) and most recruitment stock produced from these individuals. Older females (age group III) may produce two complements of ova in a season. Secondary fecundity 459 ± 80.17 eggs for age group I fish. Few live longer than one year, but occasionally some survive into third. Adults opportunistic feeders, preferring insects. Plant materials consumed late summer through fall when insect larvae or emergents scarce. May move distances of at least one km. High discharge from localized storms disperse spinedace downstream for considerable distances.

Compiler: W. E. Rinne, August 1978.

Lepidomeda vittata Cope
Little Colorado spinedace

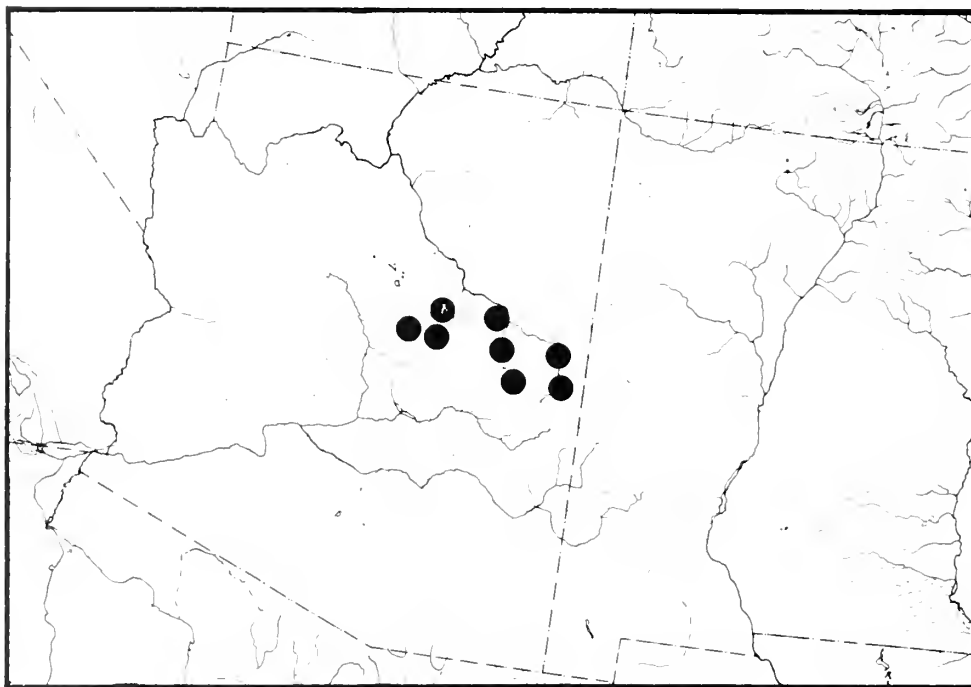
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Colorado Chiquito River, AZ (Cope 1874, Proc. Am. Philos. Soc. 14: 129-40).

SYSTEMATICS: Miller and Hubbs (1960, Misc. Publ. Mus. Zool. Univ. Mich. 115:1-39) reviewed genus and consider it to be most generalized in the tribe Plagopterini.



AZ: Coconino Co., East Clear Creek, 79 mm SL (W. L. Minckley).



DISTRIBUTION AND HABITAT: Restricted to upper parts of Little Colorado River system, eastern AZ. Found in a variety of habitats (Miller and Hubbs 1960). Bottom consists of sand, gravel, and silt with rock and bedrock. Water may vary from clear to turbid, often cold enough for trout. Stream size varies from small to moderate. Occasionally fairly common in restricted areas, but individuals tend to be solitary (Miller 1963, Copeia:1-5).

ADULT SIZE: 84 mm SL maximum.

BIOLOGY: Miller (1963) discussed larval development and ecology. Minckley (1973, *Fishes of Arizona*) summarized general life history, spawning, and food habits. Spawning occurs mostly in early summer then sporadically throughout the remainder of the summer and early fall. Females contain from 650 to 5000 eggs. Food consists mostly of aquatic and terrestrial insects taken from surface or mid-water.

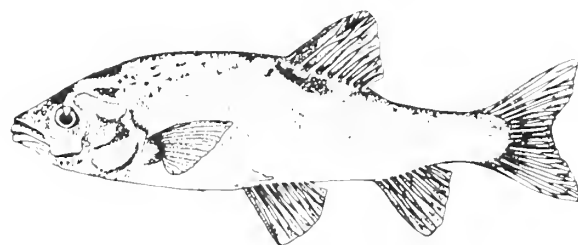
Compiler: F. C. Rohde, July 1978.

Leuciscus idus (Linnaeus)
Ide

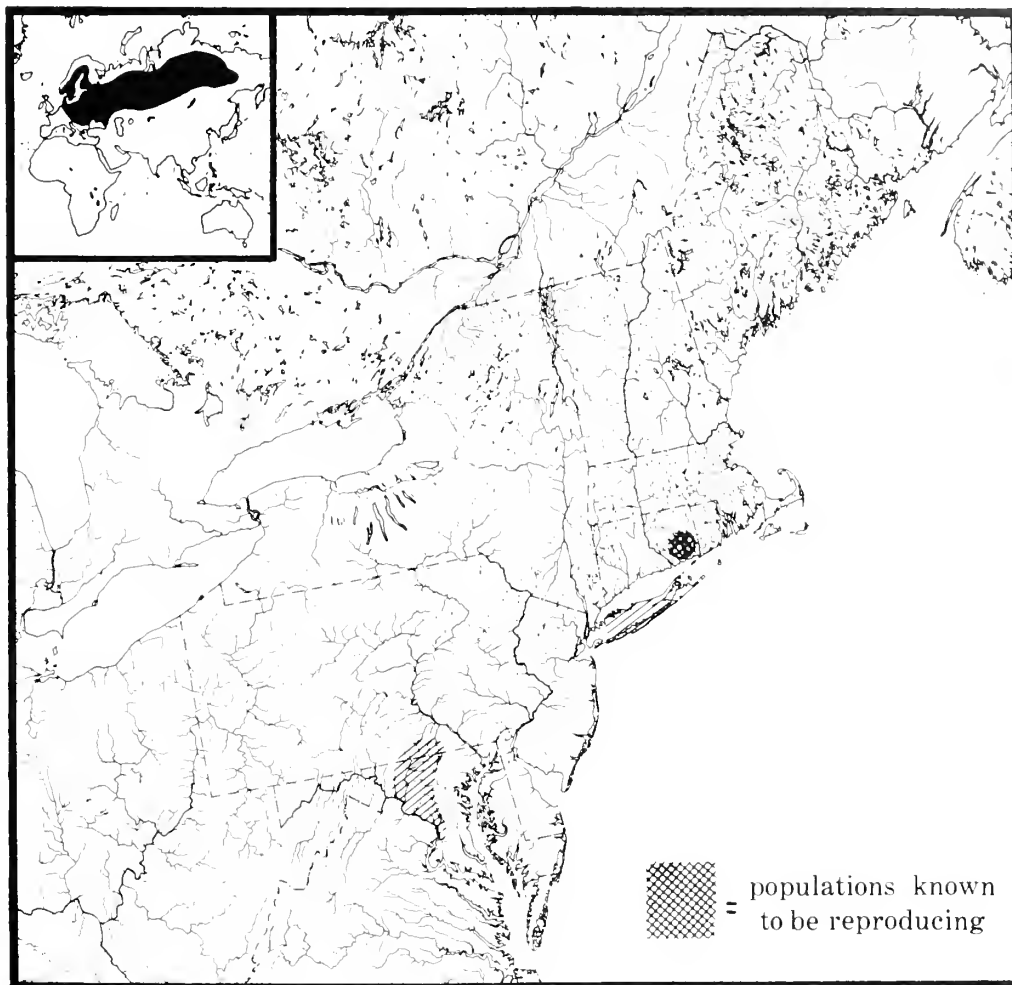
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Fresh waters of Europe (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Two subspecies, *L. i. ori-anus* and *L. i. idus* (Berg 1949. *Freshwater Fishes of the U.S.S.R. and Adjacent Countries* Vol. 2). Included in key to fishes of CT by Whitworth et al. (1968. *Freshwater Fishes of Connecticut*).



(NCSM)



DISTRIBUTION AND HABITAT: Native distribution — Still or slow-moving waters in Europe, from Rhine River eastward and Aral Sea basin. Established in CT; possibly established in PA. Has been introduced into NY and the Potomac River drainage, but establishment in these areas is doubtful. Introductions into United States due to intentional releases by a state agency and escapes from commercial and government ponds.

ADULT SIZE: In native range 335-500 mm TL, 500 mm SL maximum.

BIOLOGY: In native range feeds mainly on insects and benthic invertebrates. Adhesive eggs are attached to submerged plants and stones (Wheeler 1969. *The Fishes of the British Isles and north-west Europe*).

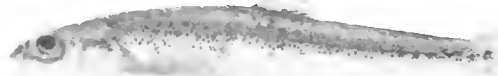
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

***Meda fulgida* Girard**
Spikedace

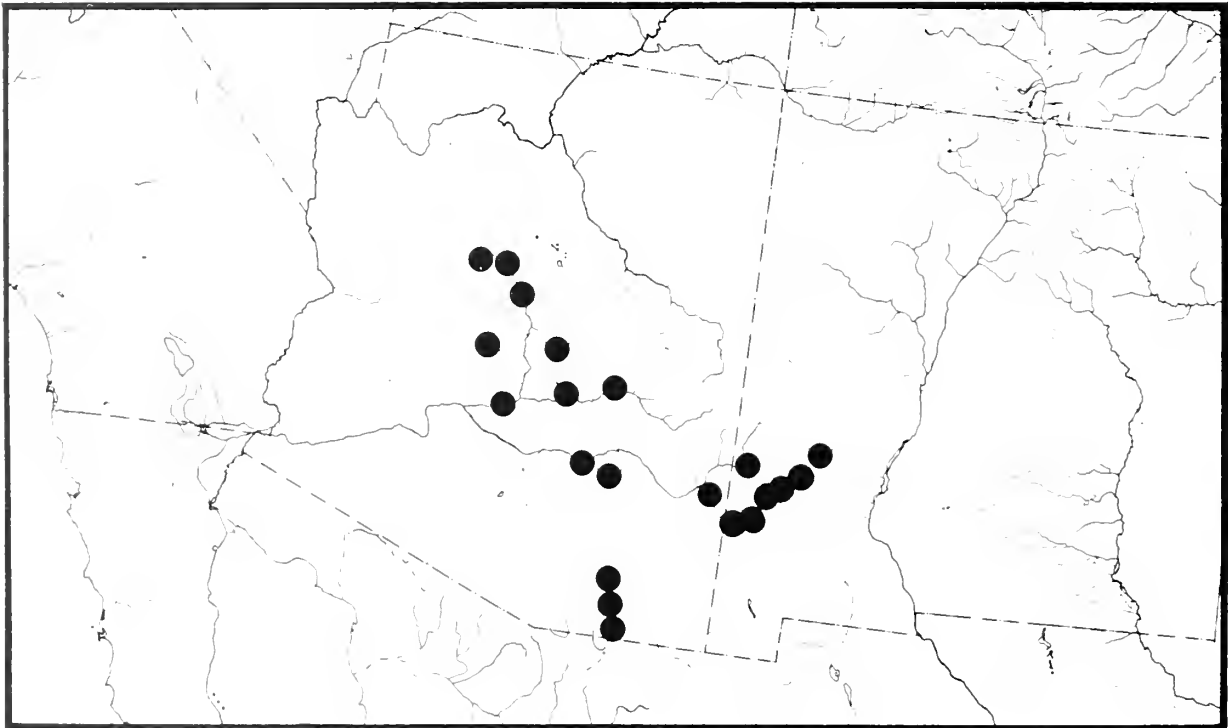
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio San Pedro, AZ
(Girard 1857, Proc. Acad. Nat. Sci. Phila.
[1856] 8:165-213).

SYSTEMATICS: Tribe Plagopterini. Miller and Hubbs (1960, Misc. Publ. Mus. Zool. Univ. Mich. 115:1-39) reviewed this and other members of tribe. Monotypic genus likely derived from *Lepidomeda*.



NM: Grant Co., Gila River, 53
mm SL (NCSM).



DISTRIBUTION AND HABITAT: Found only in Gila River system of AZ and NM. Typically inhabits swift deep pools, or deeper upper parts of long pools near riffle mouths, over sandy or gravelly bottoms. Young in backwater areas, over silt and sand bottoms, adjacent to pools. Sometimes locally common. Extirpated throughout much of its range in a relatively brief time through direct competition with introduced red shiner, *Notropis lutrensis* (Minckley and Deacon 1968, Science 159:1424-32).

ADULT SIZE: 51-76 mm.

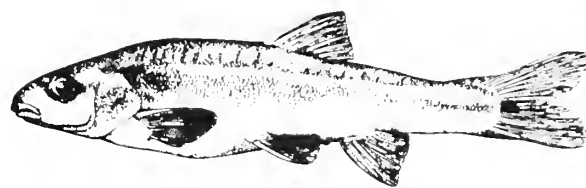
BIOLOGY: Barber et al. (1970, Copeia: 9-18) analyzed breeding habits, reproductive cycle, and age and growth. Feeds primarily on aquatic and terrestrial insects. Minckley (1973, *Fishes of Arizona*) summarized present knowledge.

Compiler: F. C. Rohde, May 1978.

Moapa coriacea Hubbs and Miller
Moapa dace

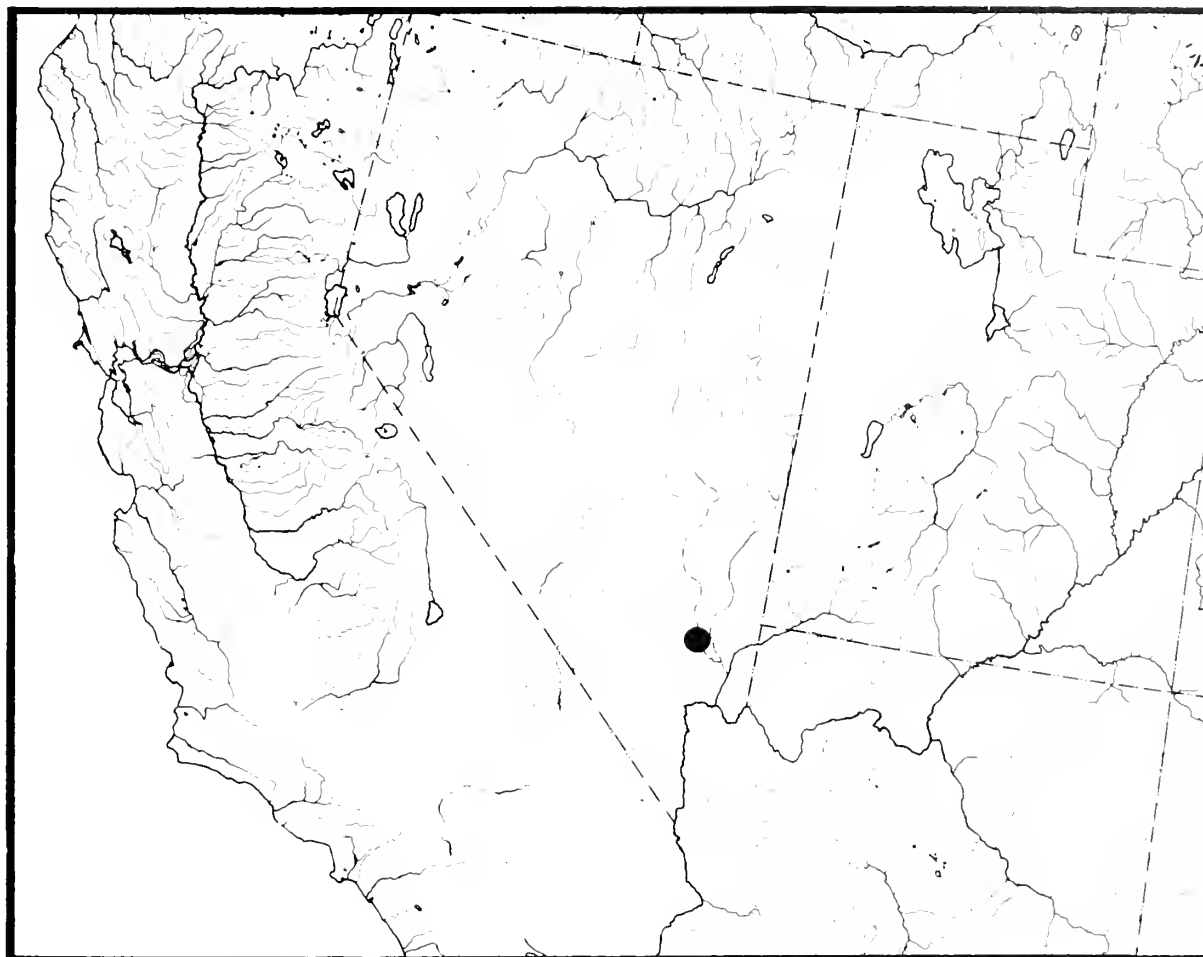
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Home Ranch, Moapa River, 12 road km nw of Moapa, Clark Co., NV (Hubbs and Miller 1948. Occas. Pap. Mus. Zool. Univ. Mich. 507:1-30).



(La Rivers 1962)

SYSTEMATICS: Monotypic genus. *Moapa* and *Agosia* were likely derived from a common ancestral type. Demonstrates affinities with *Gila* and *Rhinichthys* (Hubbs and Miller 1948).



DISTRIBUTION AND HABITAT: Known only from warm spring area of Moapa River in northern Clark Co., NV. Restricted to clear pools and outlet streams of moderate to high temperatures (19.5-33.9°C). Fluctuates from common to rare (Deacon and Bradley 1972. Trans. Am. Fish. Soc. 101: 408-19). Hubbs et al. (1974. Calif. Acad. Sci. Mem. 7:1-259) reported transplantation of 20 individuals to Spring Valley, NV, in 1972.

BIOLOGY: La Rivers (1962. *Fishes and Fisheries of Nevada*) noted schooling behavior, and found that food consisted principally of insects. Ecological distribution, native associates, and introduced competitors studied by Deacon and Bradley (1972).

ADULT SIZE: Reaches 74 mm SL.

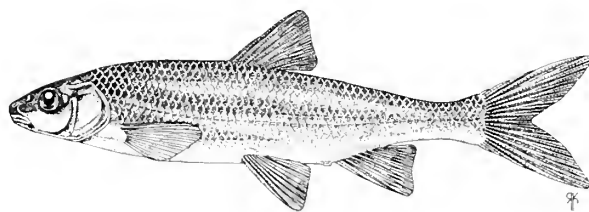
Compiler: D. S. Lee. June 1978.

Mylocheilus caurinus (Richardson)
Peamouth

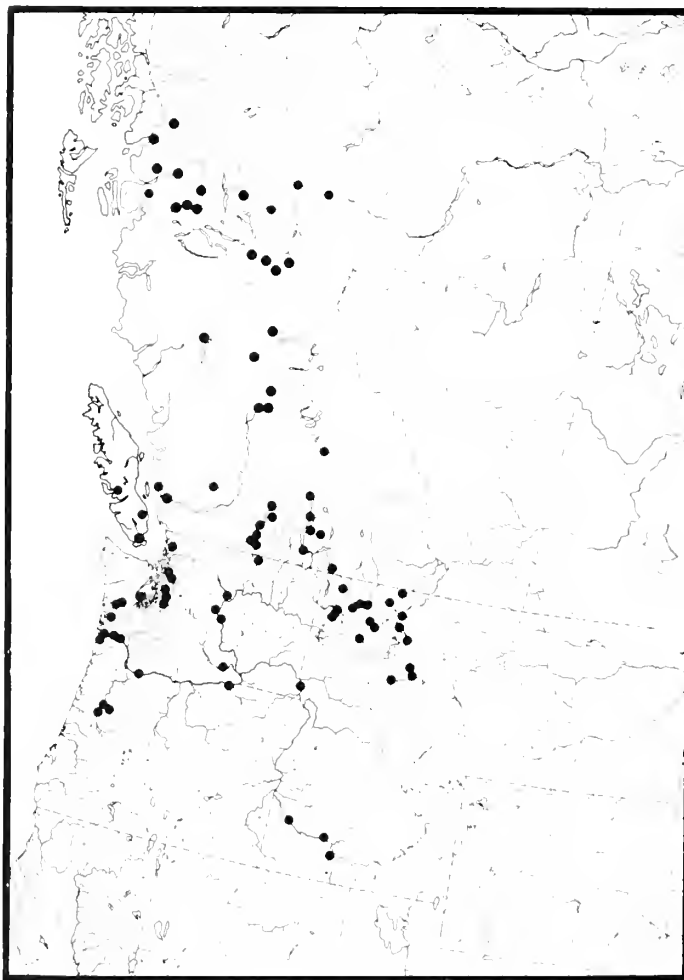
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Columbia River at Fort Vancouver (Richardson 1836, *Fauna Boreali-Americana*).

SYSTEMATICS: Originally described as *Cyprinus (Leuciscus) caurinus*. Hubbs and Schultz (1931, Occas. Pap. Mus. Zool. Univ. Mich. 232:1-6) reviewed nomenclature and concluded that correct name for fish described by Richardson is *Mylocheilus caurinus*. Weisel (1954, Copeia:278-82; 1955, Am. Midl. Nat. 53:396-411; 1955, J. Morphol. 96:333-49) reported on hybridization.



BC: Case Creek, Bridge Lake District, 157 mm SL (NCSM)



DISTRIBUTION AND HABITAT: Pacific slope drainages from Nass River, BC, to Columbia River system in OR, WN, ID, and MT. Has crossed continental divide in Peace River system, BC, and Athabasca River at Athabasca, AT. Also on Vancouver Island and some islands along BC coast (Scott and Crossman 1973, *Freshwater Fishes of Canada*). Inhabits both lakes and rivers. One of the few cyprinids that can tolerate salt water.

ADULT SIZE: 160-205 mm SL.

BIOLOGY: Schools in lakes and slow stretches of rivers. Biology studied in MT (Hill 1962, Proc. Mont. Acad. Sci. 22:27-44; Rahrer 1963, Proc. Mont. Acad. Sci. 23: 144-56) and BC (Munro and Clemens 1937, Biol. Board Can. Bull. 55:1-50; Clemens et al. 1939, Bull. Fish. Res. Board Can. 56: 1-70). Diel vertical movements in Nicola Lake, BC, described by Northcote et al. (1964, Verh. Int. Verein. Limnol. 15:940-46).

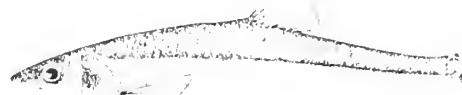
Compiler: R. L. Wallace, June 1978.

***Mylopharodon conocephalus* (Baird
and Girard)
Hardhead**

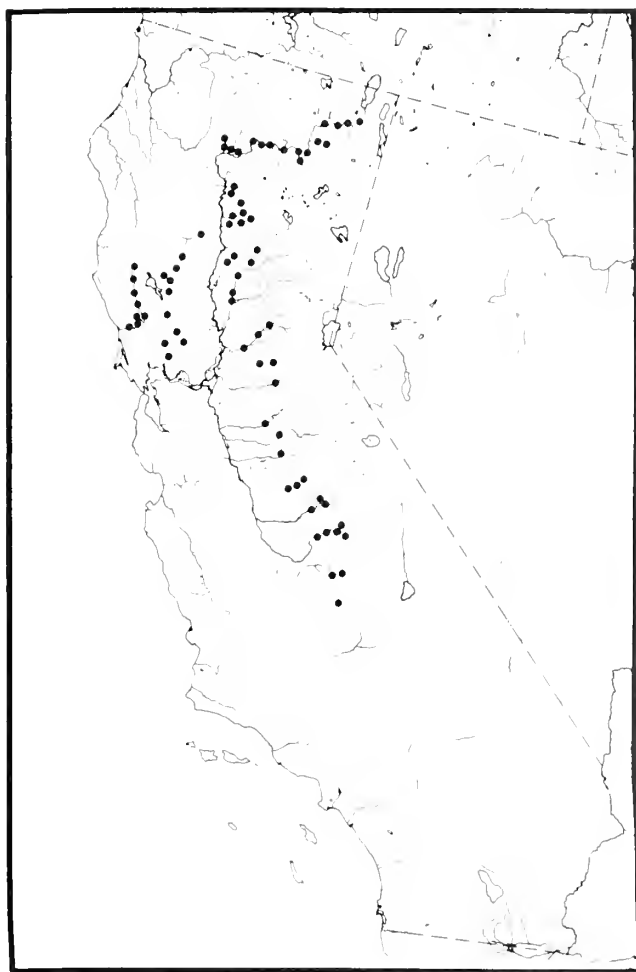
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: San Joaquin River, CA
(Baird and Girard *in* Girard 1854. Proc.
Acad. Nat. Sci. Phila. [1854-55] 7:129-40).

SYSTEMATICS: Monotypic, but most closely related to *Ptychocheilus* and perhaps should be included in this genus (Avisé and Ayala 1976. Evolution 30:46-58).



CA: Modoc Co., Ash Creek, 11
cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Primarily in undisturbed sections of larger low and mid-elevation streams of main Sacramento-San Joaquin drainage, Russian River drainage and Pit River system. Absent from Pajaro-Salinas drainage and Clear Lake basin. Almost always found in association with Sacramento squawfish, *Ptychocheilus grandis*.

BIOLOGY: Bottom feeding omnivore in deep pools. Life history summarized in Moyle (1976. *Inland Fishes of California*). Alley and Li (in press, J. Fish. Res. Board Can.) conducted detailed study of its ecology in Deer Creek, Tehama Co., CA.

ADULT SIZE: 200-500 mm SL.

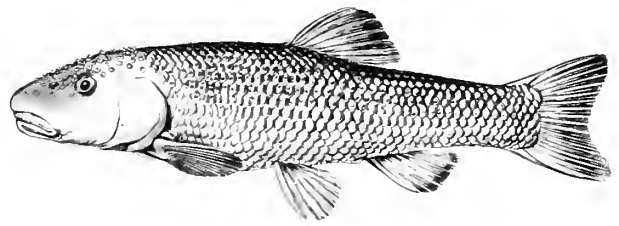
Compiler: P. B. Moyle. July 1978.

Nocomis asper Lachner and Jenkins
Redspot chub

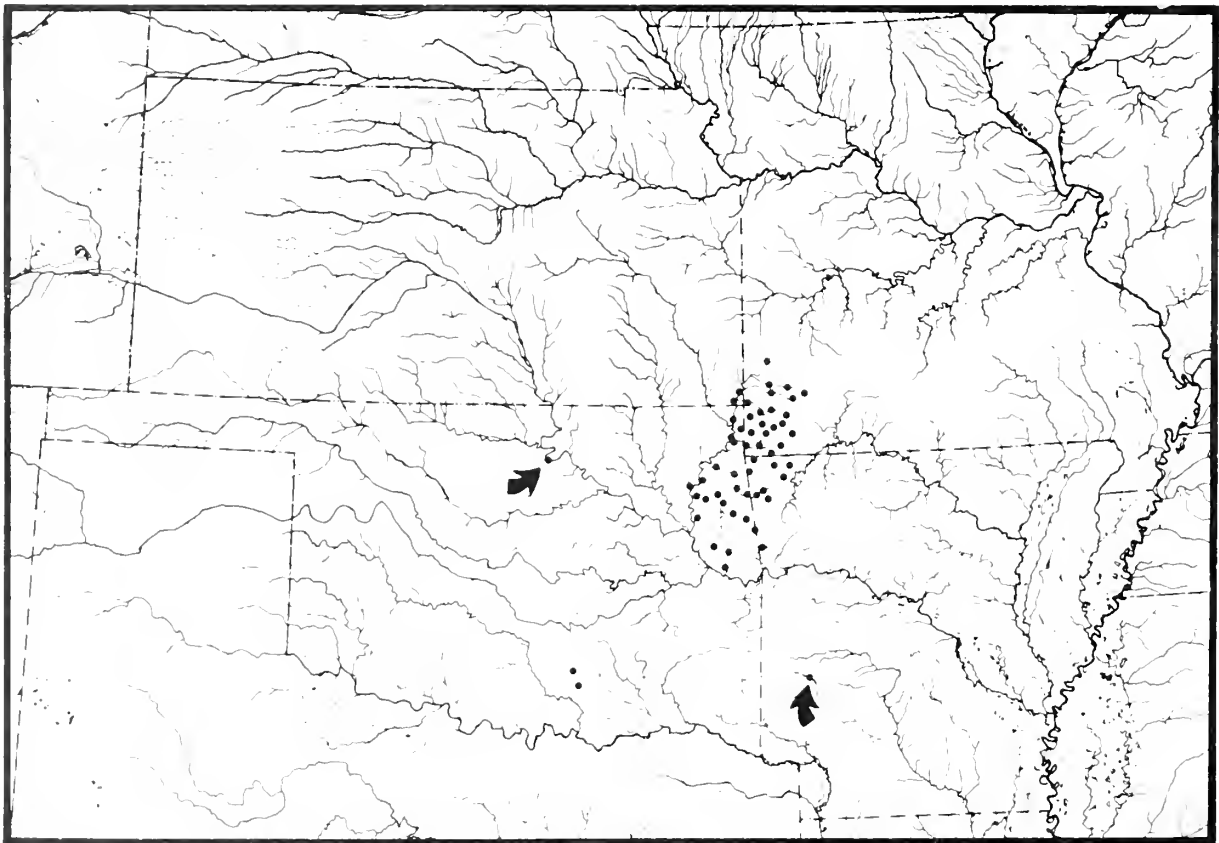
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Big Spring Creek at Camp Gailand, 8 km s of Locust Grove, Mayes Co., OK (Lachner and Jenkins 1971a. *Smithson. Contrib. Zool.* 91:1-28).

SYSTEMATICS: In *biguttatus* species group with, and allopatric to *N. biguttatus* and *N. effusus* (Lachner and Jenkins 1967. *Copeia*:557-80 [as Ozark chub]; 1971b. *Smithson. Contrib. Zool.* 85:1-97; 1971a). Elevation of *Nocomis* from subgenus of *Hypopsis* discussed by Jenkins and Lachner (1971. *Smithson. Contrib. Zool.* 90:1-15). Relationships of *Nocomis* to such other nest building genera as *Eroglossum* and *Semotilus* noted by Jenkins (1971. *ASB Bull.* 18:40) and Jenkins and Lachner (1971).



OK: Mayes Co., Big Spring Creek, male, 179 mm SL (Lachner and Jenkins 1971a).



Map modified from Lachner and Jenkins 1971a.

DISTRIBUTION AND HABITAT: Primarily Ozark Uplands of Arkansas drainage, AR, MO, KS, and OK. Disjunct, perhaps extirpated, population farther up Arkansas River, OK; one in Blue River of Red drainage, OK; one recently discovered in upper Ouachita drainage, AR (Douglas and Harris 1977. *ASB Bull.* 24:47). Inhabits small to medium-sized streams of moderate to low gradient, cool to warm, usually clear, gravelly and rocky. Found in swift water and pools. Abundance varies.

ADULT SIZE: 100-182 mm SL.

BIOLOGY: Probably similar to *N. biguttatus*. Gravel mound nest building in June, water 21-22°C (Lachner and Jenkins 1971a).

Compilers: R. E. Jenkins and E. A. Lachner.
July 1979.

Nocomis biguttatus (Kirtland)
Hornyhead chub

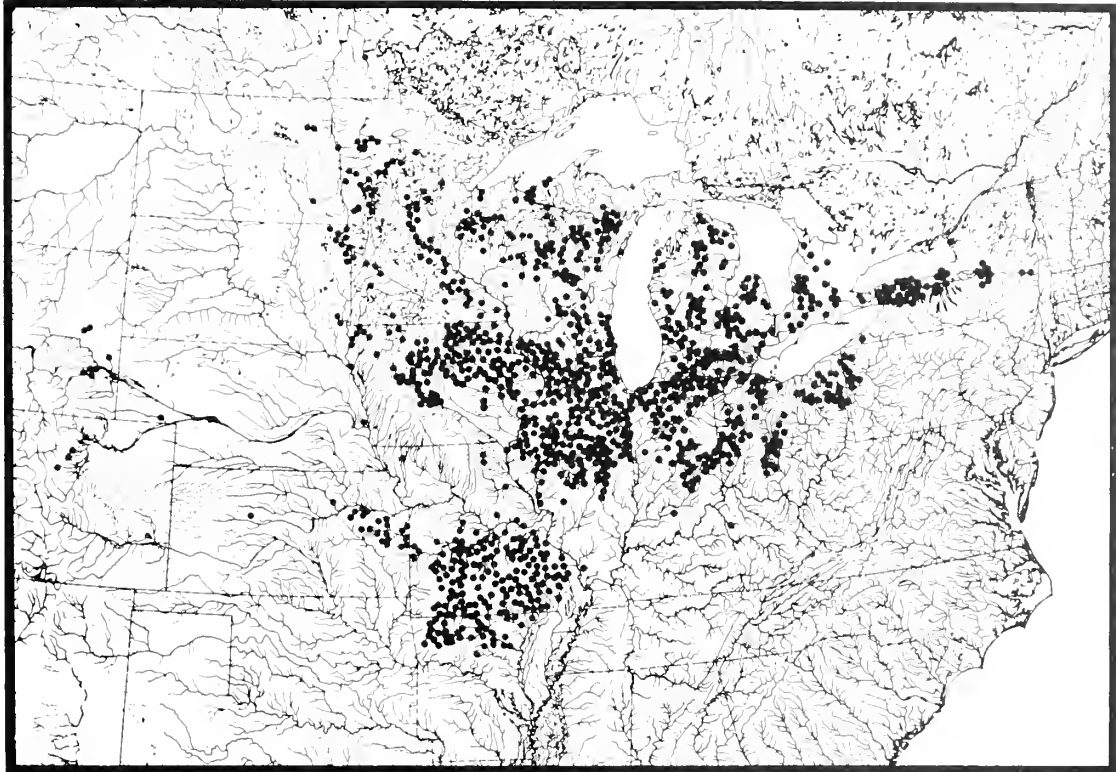
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: Yellow Creek, tributary of Mahoning River, upper Ohio River basin, OH (Kirtland 1841. Boston J. Nat. Hist. [1840-41] 3:338-52).

SYSTEMATICS: In *biguttatus* species group with, and allopatric to *N. asper* and *N. affusus* (Lachner and Jenkins 1967. Copeia:557-80; 1971a. Smithson. Contrib. Zool. 85:1-97; 1971b. Smithson. Contrib. Zool. 91:1-28).

NY: Johnson Creek, Lake Ontario drainage, male, 99 mm SL (Lachner and Jenkins 1971b).



Map modified from Lachner and Jenkins 1971b

DISTRIBUTION AND HABITAT: Widely distributed in previously glaciated areas, from Mohawk system, NY, west through Great Lakes basin to Red of North drainage, MB, south in upper Mississippi basin and northern part of Ohio basin. Avoids much of Plains in Mississippi and Missouri basins. Isolated populations in Platte and Cheyenne drainages, CO, NB, and WY. Nearly disjunct major population center in Ozarks, AR, MO, and Osage cuestas, eastern KS. Population in Kentucky drainage, KY, probably introduced. Generally occupies small to medium-sized, moderate to low gradient, cool to warm, typically clear, gravelly streams. Inhabits pools and slow to moderate runs, occasionally associated with higher aquatic plants. Often common in streams described; not common in rivers and lakes.

ADULT SIZE: 80-140 mm SL; to ca. 215 mm SL in Ozarks.

BIOLOGY: In NY, juveniles and adults feed largely on wide variety of benthic insects, with lesser amounts of crustaceans, molluscs, annelids, and fishes; algal and vascular plants taken, perhaps incidentally; young consume insects, microcrustacea and molluscs (Lachner 1950. J. Wash. Acad. Sci. 40:229-36). Matures by two years, maximum longevity four years in NY and Canada (Lachner 1952. Am. Midl. Nat. 48:433-66; Scott and Crossman 1973. *Freshwater Fishes of Canada*). Constructs gravel mound nests late April to early July. Fecundity treated by Lachner (1952) and Scott and Crossman (1973).

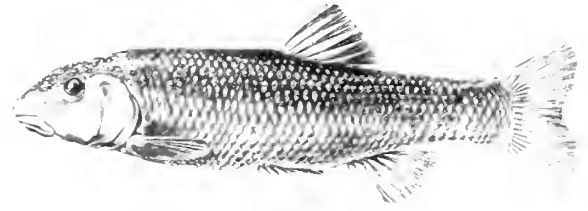
Compilers: R. E. Jenkins and E. A. Lachner. July 1979.

Nocomis effusus Lachner and Jenkins
Redtail chub

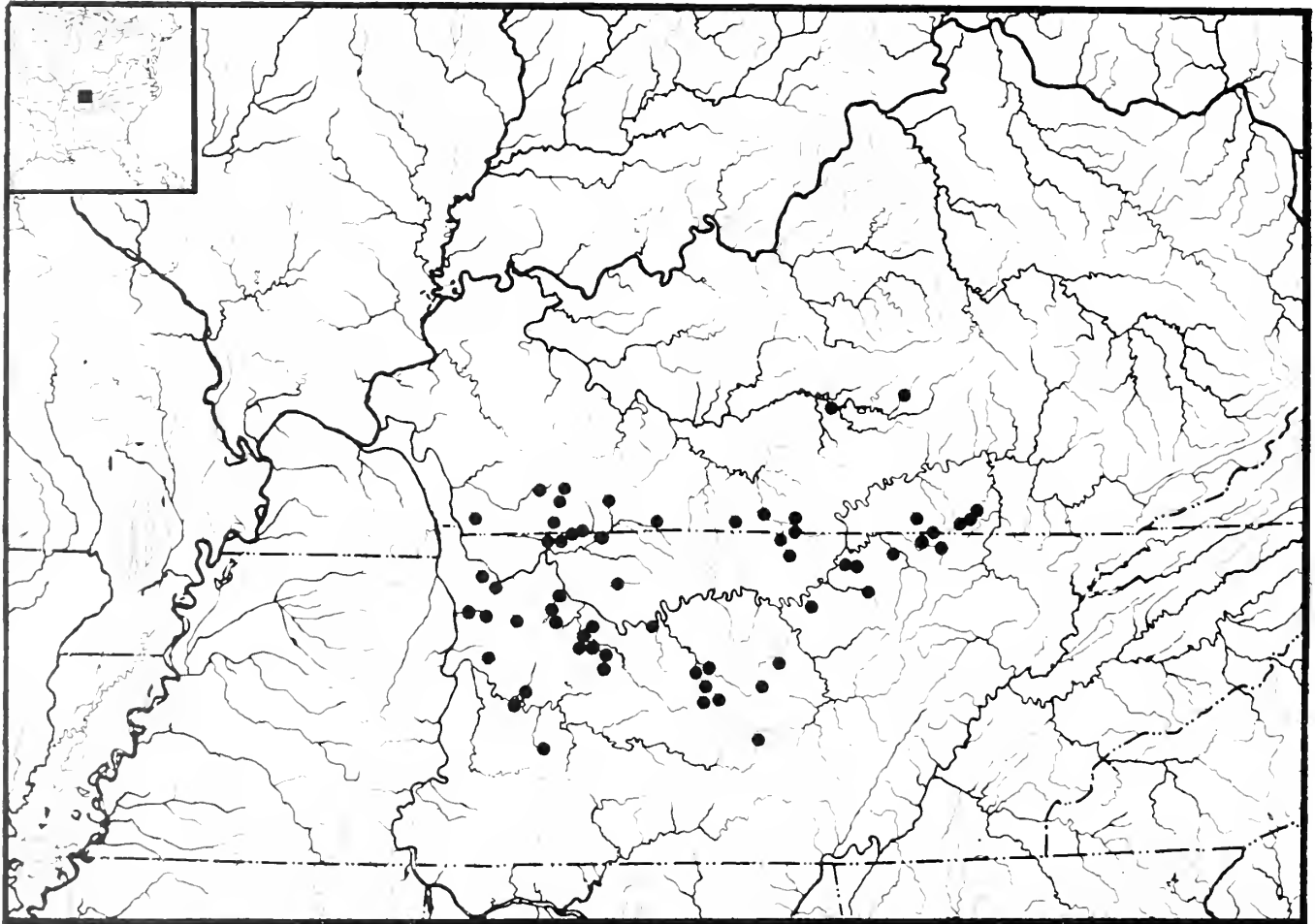
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Whippoorwill Creek, at Licksillet, near route 1041, 12.9 air km sw Russellville, Logan Co., KY (Lachner and Jenkins 1967. Copeia:557-80).

SYSTEMATICS: In *biguttatus* species group with, and allopatric to, *N. asper* and *N. biguttatus* (Lachner and Jenkins 1967; 1971a. Smithson. Contrib. Zool. 85:1-97; 1971b. Smithson. Contrib. Zool. 91:1-28).



KY: Cumberland River drainage, male, 190 mm SL (Lachner and Jenkins 1967).



Map modified from Lachner and Jenkins 1967

DISTRIBUTION AND HABITAT: Duck River system of Tennessee drainage; widely distributed in Cumberland drainage below Cumberland Falls; upper Barren and Green river systems of Green drainage, TN, KY. Inhabits small to medium-sized streams of moderate gradient, cool to warm, usually clear, gravelly and rocky. May have affinity for high volume spring streams. Favors pools and slower runs. Generally uncommon to rare.

ADULT SIZE: 85-195 mm SL.

BIOLOGY: Probably similar to *N. biguttatus*. Gravel mound nest building in late May to mid-June, water 18-24°C (in part Lachner and Jenkins 1967).

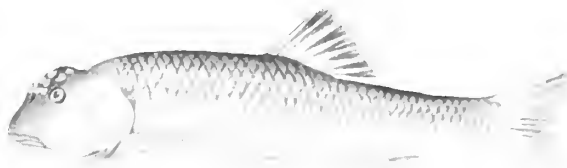
Compilers: R. E. Jenkins and E. A. Lachner, July 1979.

Nocomis leptocephalus (Girard)
Bluehead chub

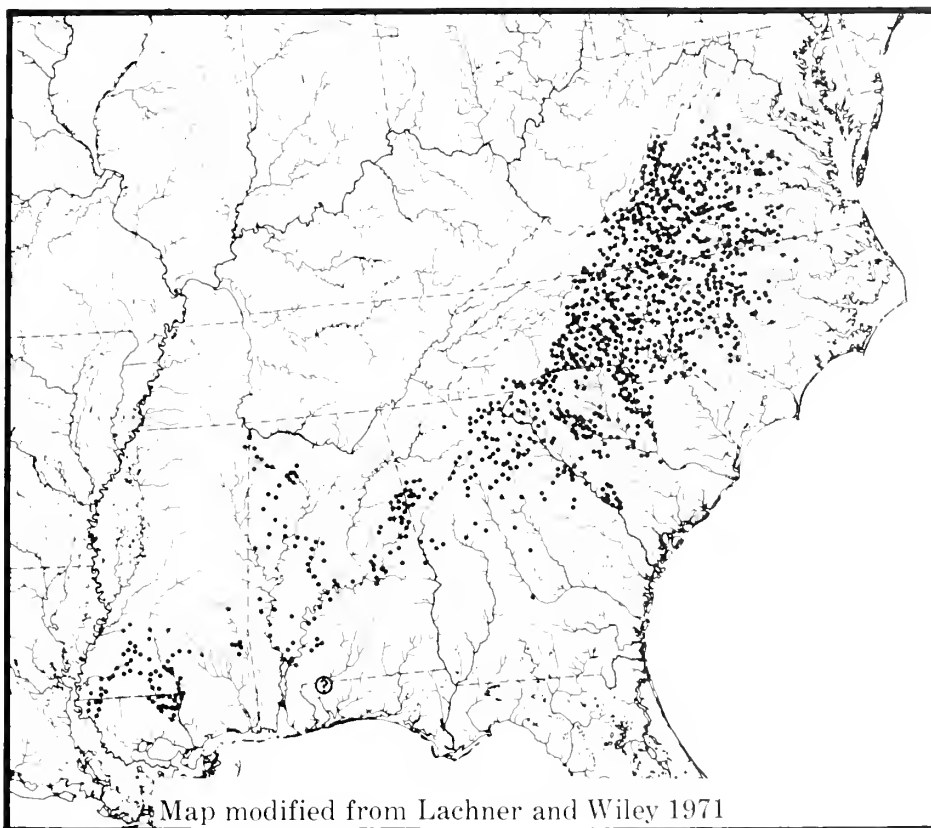
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Salem, NC [now part of Winston-Salem; locality apparently in Yadkin system of Peedee drainage] (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Constitutes *leptocephalus* species group (Lachner and Jenkins 1967. Copeia:557-80; 1971. Smithson. Contrib. Zool. 85:1-97). Three subspecies: *N. l. leptcephalus* in northern part of range, *N. l. interocularis* in middle, *N. l. bellicus* in southwest (Lachner and Wiley 1971. Smithson. Contrib. Zool. 92:1-35).



VA: Roanoke River drainage,
Dan River, male, 165 mm SL
(Lachner and Jenkins 1971).



Map modified from Lachner and Wiley 1971

DISTRIBUTION AND HABITAT: Atlantic slope from Shenandoah system and South Fork of South Branch Potomac River, VA, south to Altamaha drainage, GA. Gulf slope in Apalachicola, Mobile, Pascagoula and Pearl drainages, GA to AL. Apparently absent from Lake Pontchartrain drainage, but occupies certain tributaries of lower Mississippi River, LA and MS. In Ohio basin, widespread in New (upper Kanawha) drainage, NC, VA, barely entering WV; widespread in Bear Creek system of lower Tennessee drainage, AL, MS and TN; localized, probably introduced in upper Little Tennessee system, NC. Typical of small to medium-sized, high to low gradient, cool to warm streams that are usually clear to generally turbid and with highly varied substrate, bedrock to much sand and silt, but with at

least moderate sized areas of gravel. Occupies swift currents and pools. Common in many areas, becoming generally uncommon in southwest part of range.

ADULT SIZE: 70-170 mm SL; maximum 214 mm SL in Savannah drainage.

BIOLOGY: Diet insects, crustaceans and, particularly, algae (Flemer and Woolcott 1966. Chesapeake Sci. 7:75-89). Matures in about two years, lives four years (Lachner 1952. Am. Midl. Nat. 48:433-66). Builds gravel mound nests from April to early July, mostly prior to mid-June. Fecundity considered by Lachner (1952).

Compilers: R. E. Jenkins and E. A. Lachner, July 1979.

Nocomis micropogon (Cope)
River chub

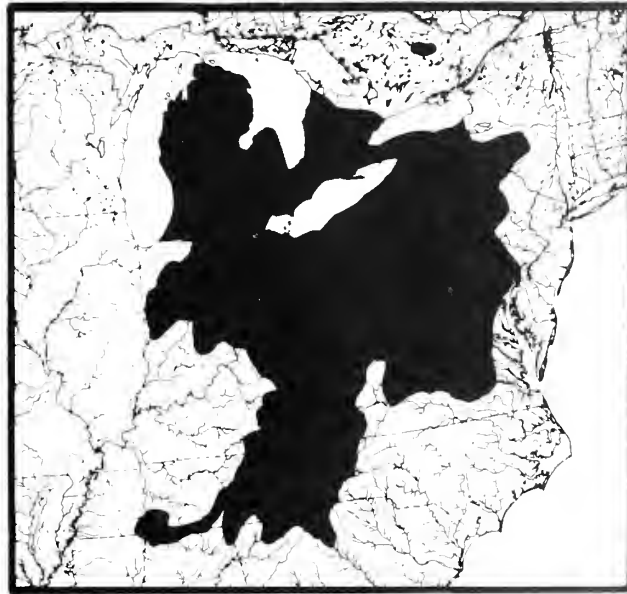
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Conestoga River, tributary of Susquehanna River, PA (Cope 1865, Proc. Acad. Nat. Sci. Phila. 16:276-85).

SYSTEMATICS: In *micropogon* species group with *N. platyrhynchus* and *N. rancyi* (Lachner and Jenkins 1967, Copeia:557-80; 1971, Smithson. Contrib. Zool. 85: 1-97). Most closely related and allopatric to *N. platyrhynchus*; Monongahela drainage population of *N. micropogon* shows effects of past introgression with *N. platyrhynchus*. Sympatric with but largely allotopic to *N. rancyi* in James drainage (Lachner and Jenkins 1971).



MD: Baltimore — Harford Co., Little Gunpowder River (NCSM).



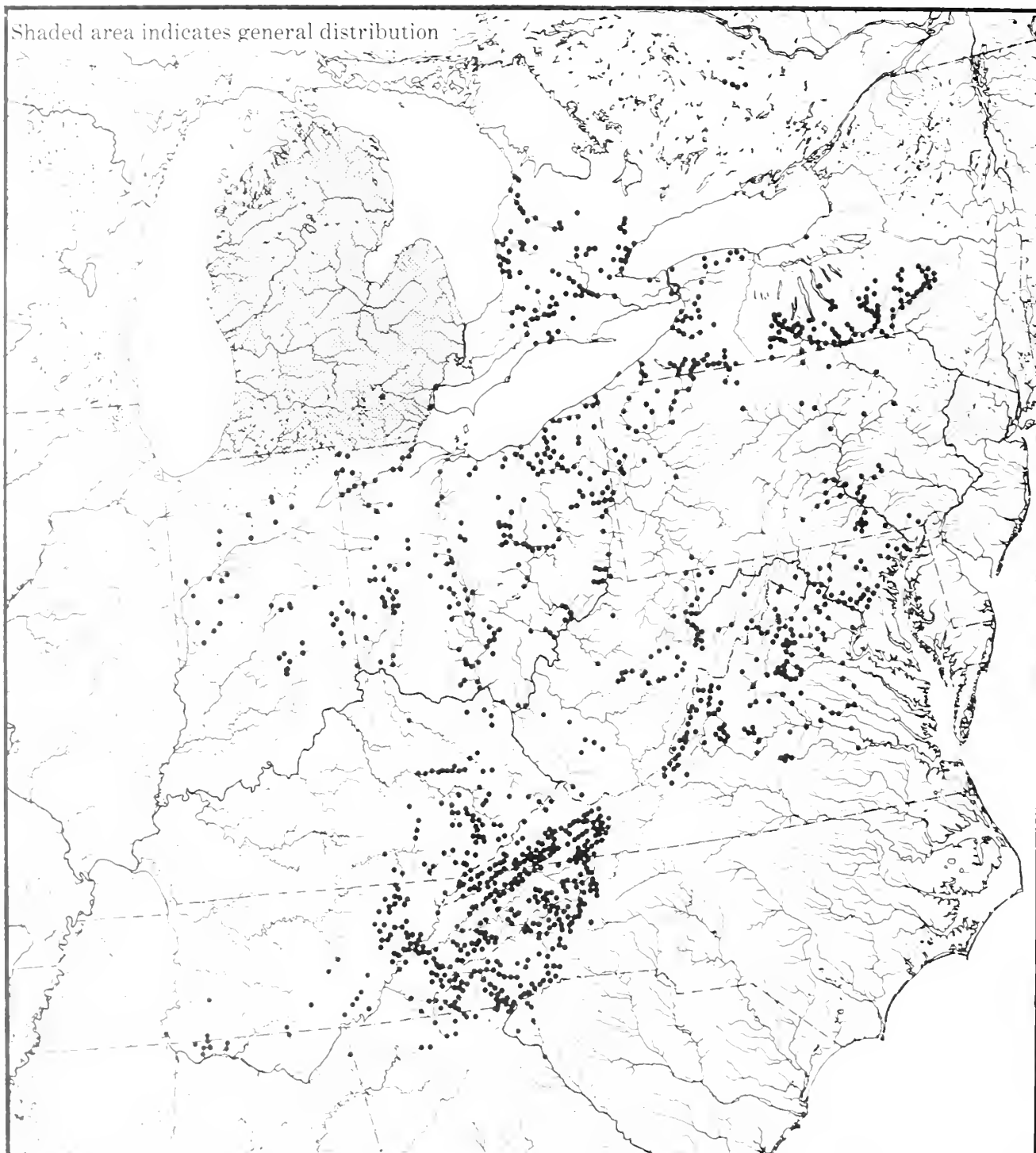
See map on next page

DISTRIBUTION AND HABITAT: Atlantic slope largely above Fall Line from Susquehanna drainage, NY, south to James drainage, VA; also in upper Santee (introduced?) and Savannah drainages and Coosa system (introduced?) of Mobile drainage, NC and GA. Widespread in Ohio basin, GA and AL north to IN and NY, except absent in much of central western part. Eastern four Great Lakes drainages, including "entire Lower Peninsula of Michigan" (Hubbs and Lagler 1958, *Fishes of the Great Lakes Region*). Apparently introduced in Ottawa River drainage, ON (Goodechild and Tilt 1979, Can. Field-Nat. 90:491-92). Record for QU (Scott and Crossman 1973, *Freshwater Fishes of Canada*) apparently erroneous. Prefers medium-sized streams of high to moderate gradient, usually clear, warm water, and gravel to boulder substrates. Inhabits swift current and pools. Often common.

ADULT SIZE: 90-180 mm SL; exceptional maximum an old specimen ca. 270 mm SL.

BIOLOGY: Food of juveniles and adults benthic insects, crayfish, molluscs, algae, and vascular plants; young consume insects, microcrustaceans, snails and plants (Lachner 1950, J. Wash. Acad. Sci. 40:229-36). Matures by two years, lives about five years (Lachner 1952, Am. Midl. Nat. 44:433-66; Scott and Crossman 1973). Constructs gravel mound nests in May and June. Fecundity treated by Lachner (1952). Eggs and larval and juvenile development described by Cooper (1979, M.S. thesis Frostburg State College).

Compilers: R. E. Jenkins and E. A. Lachner, July 1979.



Distribution of river chub, *Nocomis micropogon*

Nocomis platyrhynchus Lachner and
Jenkins
Bigmouth chub

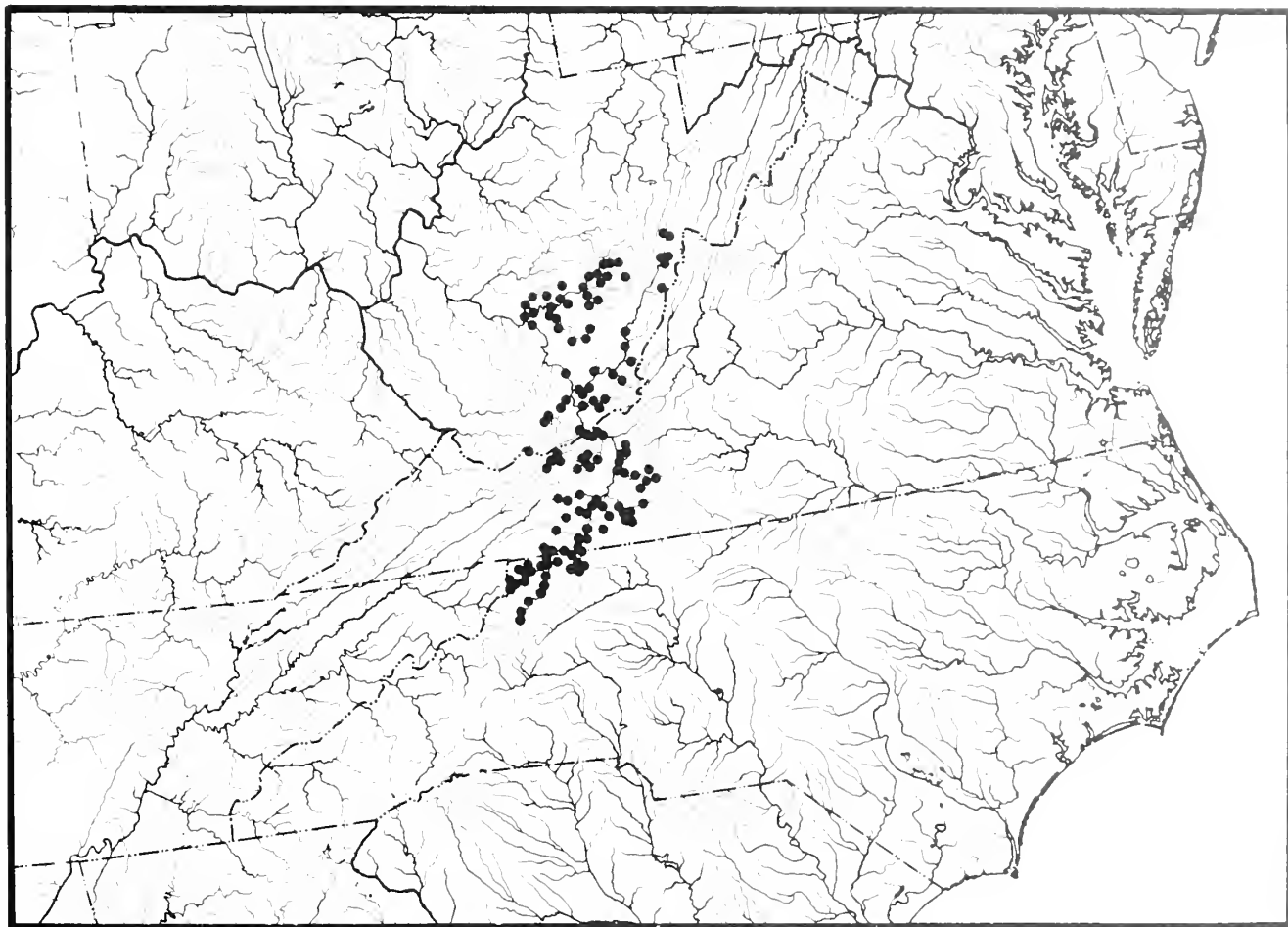
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Big Walker Creek, tributary of New River, 0.4 road km w of Bland-Giles Co. line on route 670, Bland Co., VA (Lachner and Jenkins 1971. *Smithson. Contrib. Zool.* 85:1-97).

SYSTEMATICS: In *micropogon* species group with, and allopatric to, *N. micropogon* and *N. raneyi* (Lachner and Jenkins 1967. *Copeia*:557-80; 1971). Most closely related to, and in past apparently introgressed with, *N. micropogon* in Monongahela drainage.



NC: Alleghany Co., New River,
109 mm SL (NCSM).



Map modified from Lachner and Jenkins 1971.

DISTRIBUTION AND HABITAT: Endemic and widespread in New (upper Kanawha) drainage, NC, VA, and WV. Inhabits medium-sized streams to main channel New River, of moderate gradient, warm, usually clear water, and with gravel to boulder substrates. Occupies swift water and pools. Variable abundance.

ADULT SIZE: 90-214 mm SL.

BIOLOGY: Probably similar to *N. micropogon*. Constructs gravel mound nest in May and June.

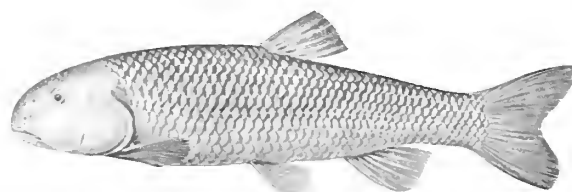
Compilers: R. E. Jenkins and E. A. Lachner.
July 1979.

Nocomis raneyi Lachner and Jenkins
Bull chub

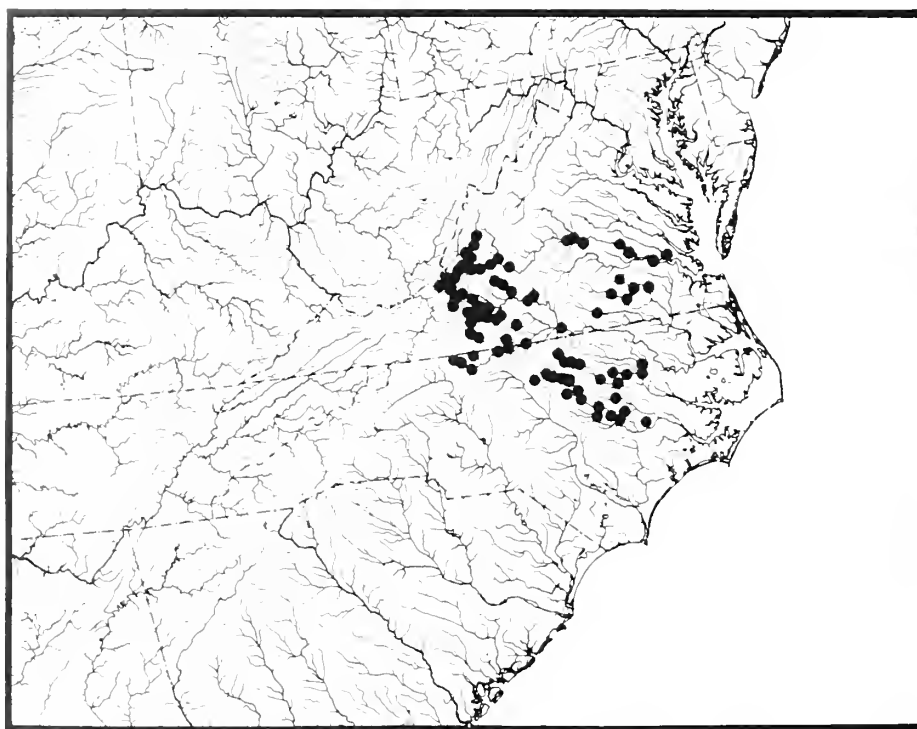
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Craig Creek, tributary of James River, at route 311 bridge, 3.5 road km sw of Newcastle, Craig Co., VA (Lachner and Jenkins 1971. *Smithson. Contrib. Zool.* 85:1-97).

SYSTEMATICS: In *micropogon* species group with sympatric but largely allotypic *N. micropogon* and allopatric *N. platyrhynchos* (Lachner and Jenkins 1967. *Copeia*: 557-80; 1971). Atypical *N. raneyi* reported from lower Craig Creek and vicinity in James drainage by Lachner and Jenkins (1971); more recent specimens from above that area, in Cowpasture River system and in middle and lower James, are typical.



VA: Craig Co., Roanoke River, male, 229 mm SL (Lachner and Jenkins 1971).



Map modified from Lachner and Jenkins 1971

DISTRIBUTION AND HABITAT: Atlantic slope from James drainage south to Neuse drainage, VA and NC, largely above Fall Line. Occupies medium-sized streams to rivers that are of moderate gradient, warm, usually clear, and have gravelly to rocky sections. Found in swift water and pools. Abundance variable.

ADULT SIZE: 100-266 mm SL. The largest *Nocomis* species today.

BIOLOGY: Based on few specimens, food is benthic insects, crayfish, snails, fish, and filamentous algae. Several large males in fourth and fifth year of life (Lachner and Jenkins 1971). Gravel and stone mound nests made mid-May to June.

Compilers: R. E. Jenkins and E. A. Lachner. July 1979.

Notemigonus crysoleucas (Mitchill)
Golden shiner

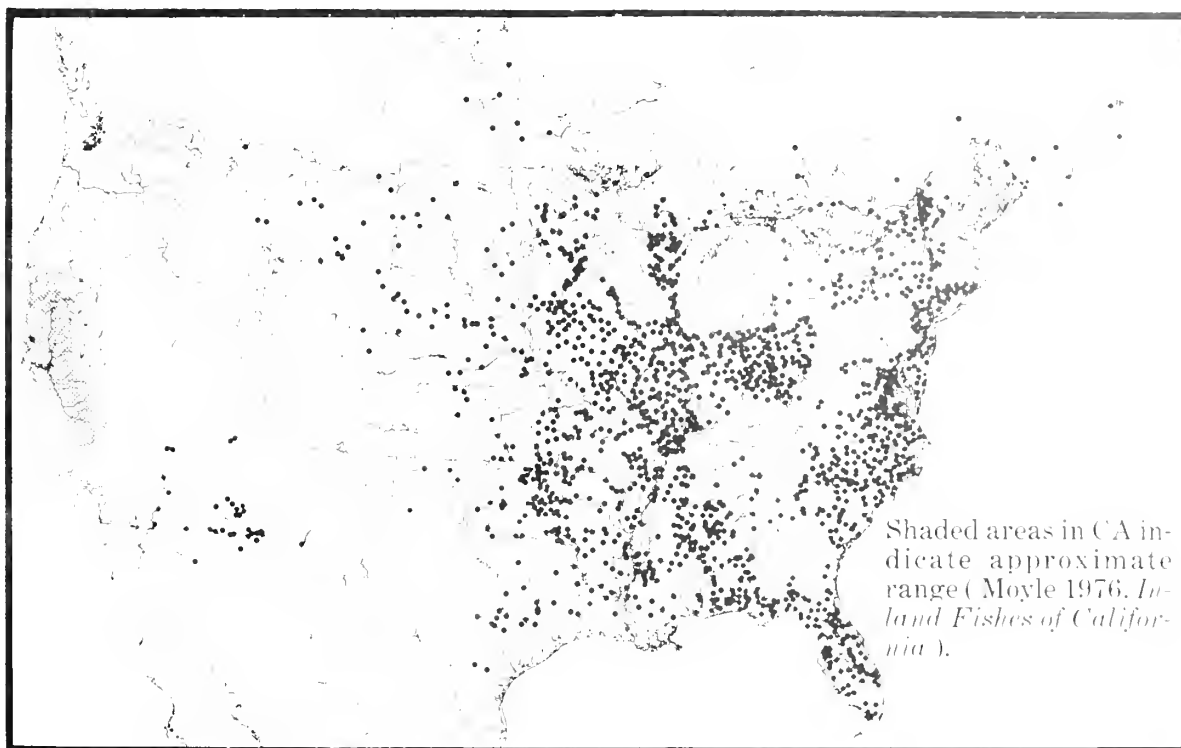
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: New York (Mitchill 1814. Rept. on Fishes of New York: 1-30).

SYSTEMATICS: Possibly more closely related to certain Eurasian cyprinids than to any North American group (Gosline 1974. Jap. J. Ichthyol. 21: 9-15). Three subspecies have been recognized — *N. c. crysoleucas* in northeast, and *N. c. auratus* and *N. c. boscii* in south — but recent authors have not considered these valid. Variation in anal fin ray count appears to be influenced by water temperature during development (Hubbs 1921. Trans. Ill. State Acad. Sci. 11: 147-51; Schultz 1927. Pap. Mich. Acad. Sci. Arts Letts. [1926] 7: 417-32). Scott and Crossman (1973. *Freshwater Fishes of Canada*) discussed and provided additional data on geographic variation in this character.



MD: Anne Arundel Co., Lake Waterford, 101 mm SL (NCSM).



Shaded areas in CA indicate approximate range (Moyle 1976. *Inland Fishes of California*).

DISTRIBUTION AND HABITAT: On Atlantic slope from Maritime Provinces south to FL, west to TX, and north to SA. Widely used as bait and ornamental thus transplanted into many areas including parks, in United States. Miller (1952. Calif. Fish Game 33:7-42) provided details on stocking in southwest. Prefers clean, quiet, vegetated water with access to extensive shallows. Common to abundant in ponds and lakes. Often in streams and rivers where, in sluggish sections, it may be abundant.

ADULT SIZE: 53-234 mm SL.

BIOLOGY: Because of value as forage species, considerable information is available concerning propagation and biology (see Carlander 1969. *Freshwater Fishery Biology* Vol. 1 for summary). Keast and Webb (1966. J. Fish. Res. Board Can. 23: 1845-67) studied foods and concluded it was surface and midwater feeder. Scott and Crossman (1973) provided summary of general biology.

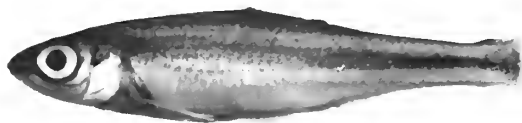
Compiler: D. S. Lee. March 1978.

Notropis albeolus Jordan
White shiner

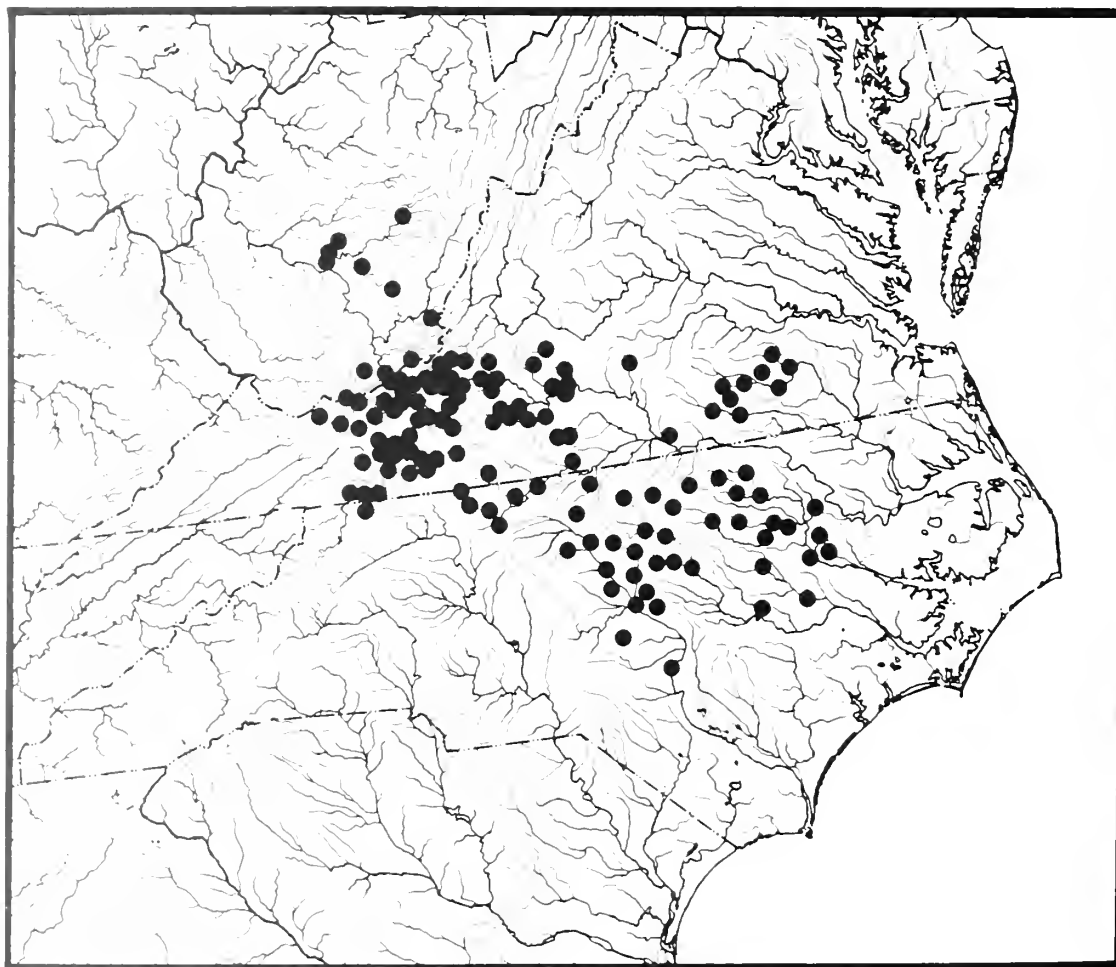
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Roanoke River, near Roanoke, VA (Jordan 1889. Bull. U. S. Fish Comm. [1888] 8:97-173).

SYSTEMATICS: Subgenus *Luxilus*. Gilbert (1964. Bull. Fla. State Mus. Biol. Sci. 8:95-194) reviewed systematics and determined that it was most closely related to *N. cornutus*. Populations in New and Roanoke river drainages differ from those to south in usually having more slender and terete body. Menzel (1976. Biochem. Syst. Ecol. 4:281-93) and Buth (in press. Biochem. Syst. Ecol.) studied biochemical relationships.



NC: Rockingham Co., Mayo River, 65 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upper Cape Fear River drainage, NC, north to Roanoke (including Chowan) River drainage, VA and NC. Also in upper New River drainage, NC, VA, and WV, where possibly introduced. Prefers clear to moderately turbid, medium-sized streams containing riffles and flowing pools, with rubble or rubble-gravel substrate. Common.

ADULT SIZE: ca. 130 mm SL maximum.

BIOLOGY: No definitive biological study published, but details of life history, food habits, and reproductive behavior probably very similar to those of *N. cornutus*.

Compiler: C. R. Gilbert. August 1978.

***Notropis alborus* Hubbs and Raney**
Whitemouth shiner

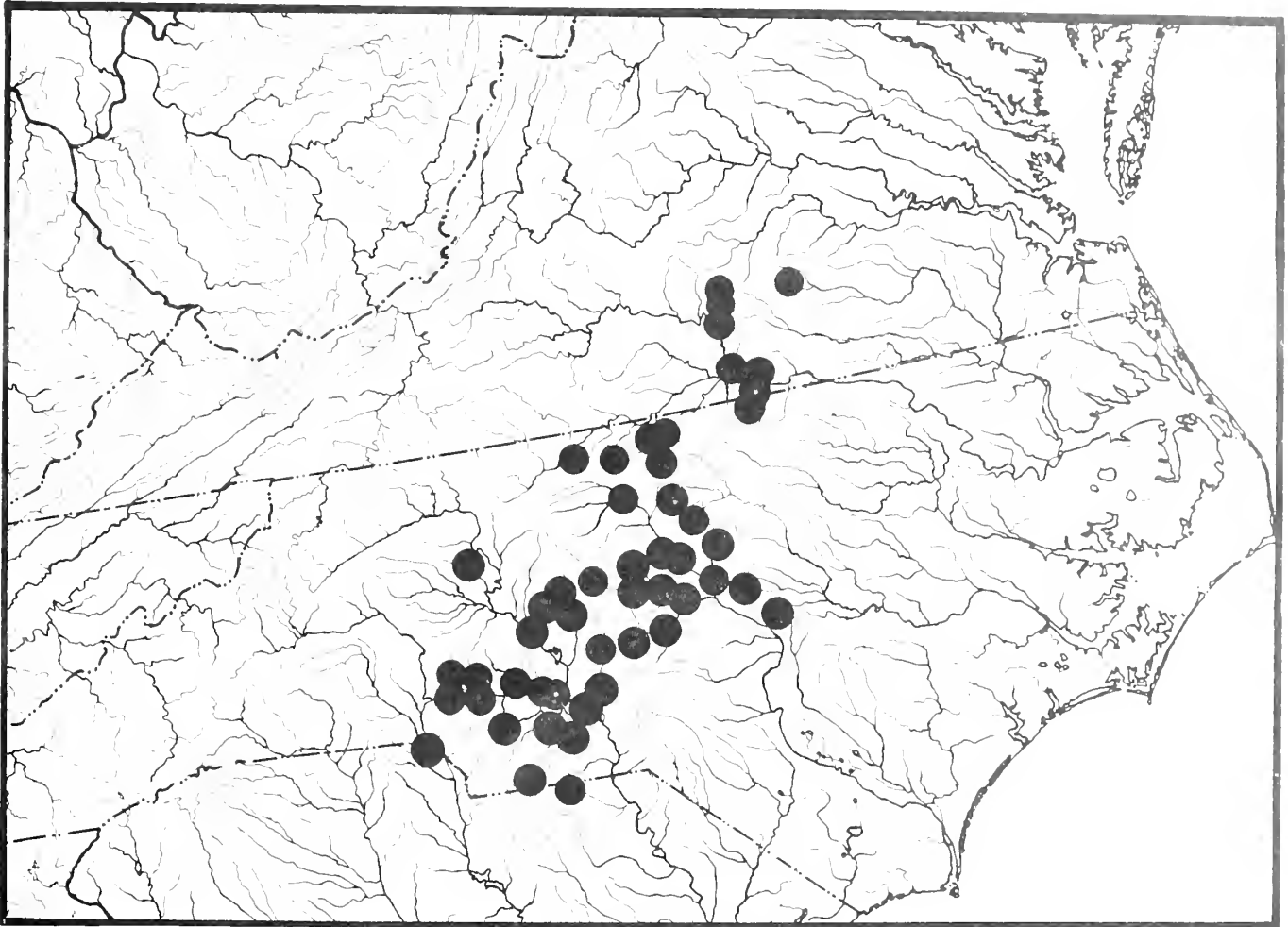
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Brush Creek, tributary to Deep River, 8 km w of Siler City, Randolph Co., NC (Hubbs and Raney 1947. Occas. Pap. Mus. Zool. Univ. Mich. 498: 1-17).

SYSTEMATICS: Of those species occurring on the middle Atlantic slope, it is most closely related to *N. proen*, *N. volucellus*, *N. bifrenatus* and *N. mekistocholas*. Geographically more distant relatives include *N. heterolepis*, *N. stramineus*, and *N. atrocaudalis*.



NC: Chatham Co., Bear Creek,
50 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Atlantic slope from Pee Dee River drainage of NC north to Roanoke drainage of NC and VA. Occurs largely on outer half of Piedmont Province. Apparently absent from intervening Tar and Neuse river drainages. Occurs in small (3 m) to medium-sized (10-20 m) streams having colorless or slightly stained, clear to turbid water, no higher vegetation, and a sand-rubble-bedrock substrate. Current rather swift, with alternating pools and riffles. Moderately common.

ADULT SIZE: ca. 38 mm SL, 50 mm SL maximum.

BIOLOGY: Not studied.

Compiler: C. R. Gilbert. February 1979.

Notropis altipinnis (Cope)
Highfin shiner

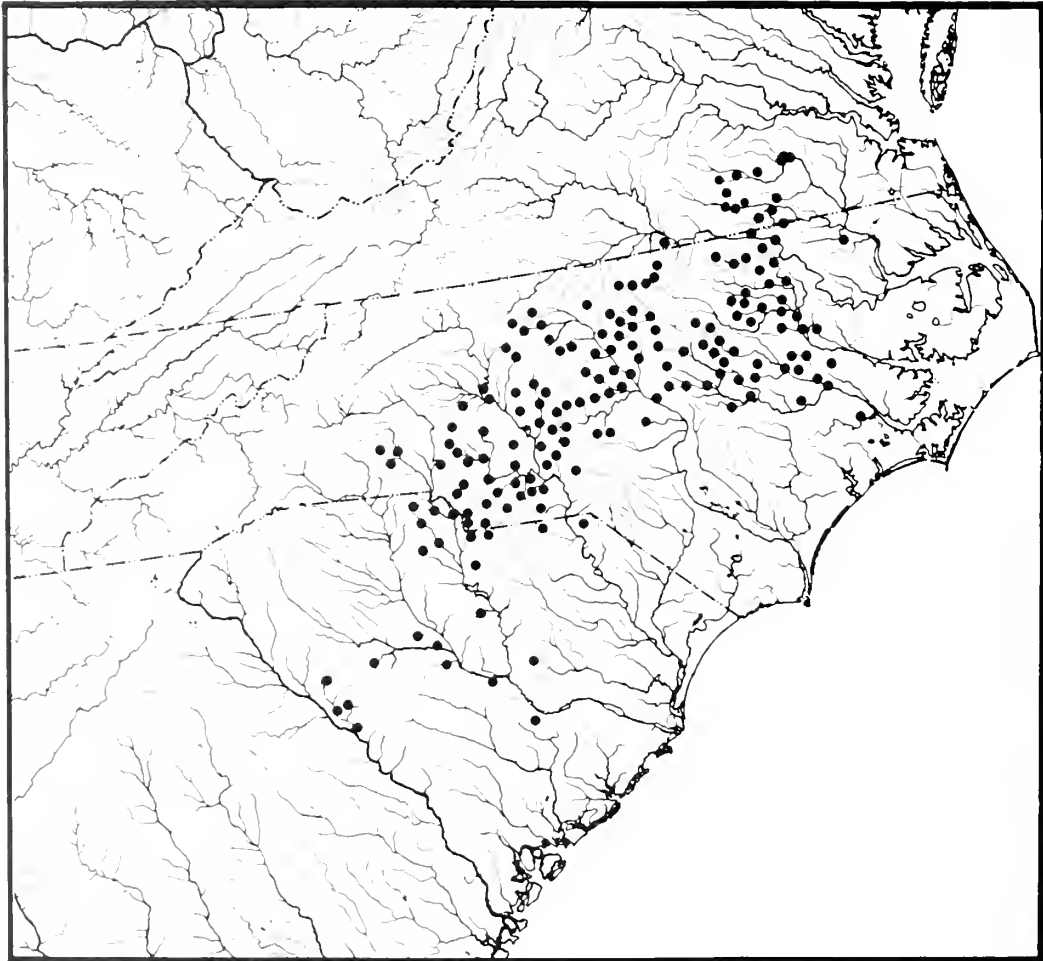
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Yadkin River, Roane (=Rowan) Co., NC (Cope 1870. Proc. Am. Philos. Soc. 11:448-95).

SYSTEMATICS: Hubbs (1941. Copeia: 165-74) and Hubbs and Raney (1948. Occas. Pap. Mus. Zool. Univ. Mich. 506:1-20) reviewed systematics, noting considerable local variation. Hubbs and Raney (1948) recognized six subspecies, not generally accepted today as valid. Precise relationships of species not determined, but closely resembles *N. cummingsae*. The two are sympatric throughout much of range and frequently confused.



NC: Wake Co., Crabtree Creek,
39 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Lower Roanoke River drainage (including Chowan system), southeastern VA, south in Piedmont and Coastal Plain areas to middle Savannah River drainage, SC (FSM 14947; recent collection). Inhabits shallow, generally small streams (averaging 3-10 m wide) usually lacking vegetation, with substrate of sand and gravel (occasionally rubble); bedrock outcrops sometimes present. Water varies from white to brown, with moderate current.

ADULT SIZE: ca. 35-51 mm SL.

BIOLOGY: Nothing published. Biology of species in VA under study at Virginia Commonwealth University.

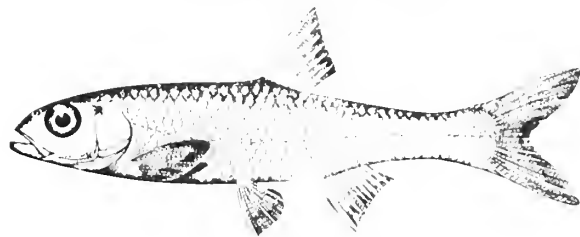
Compilers: C. R. Gilbert and G. H. Burgess,
August 1979.

***Notropis amabilis* (Girard)**
Texas shiner

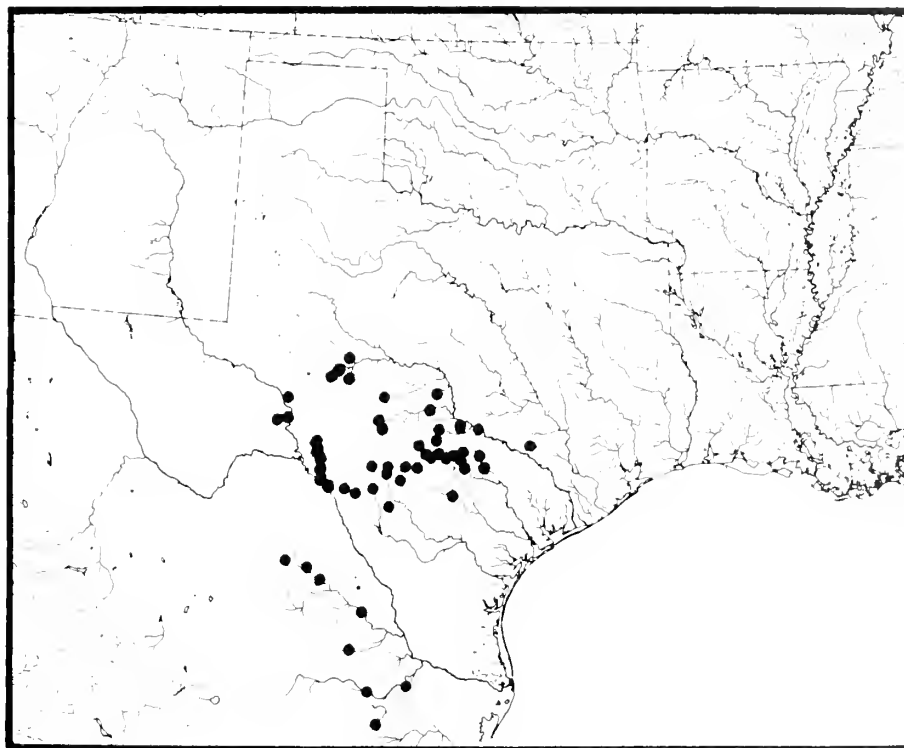
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio Leona, tributary to Rio Nueces, Uvalde, Uvalde Co., TX (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Snelson (1968. Copeia: 776-802) indicated most likely related to members of subgenus *Notropis*. No study published on infraspecific variation.



TX: San Marcos River, San Marcos, ca. 55 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: From Colorado River to Rio Grande drainages in TX and northeastern Mexico. In Rio Grande found in Rio San Juan and Rio Salado systems, Mexico, upstream to lower Pecos River TX, but apparently no farther (Hubbs et al. 1977. Symposium on importance, preservation and management of riparian habitat, Tucson, AZ: 91-97). Typically in springs and headwater tributaries, where may be very common, but sometimes occurs in more limited numbers in larger streams. Water usually clear, and substrate typically of sand, gravel and rubble.

ADULT SIZE: Not determined. At least 45 mm SL.

BIOLOGY: Not studied.

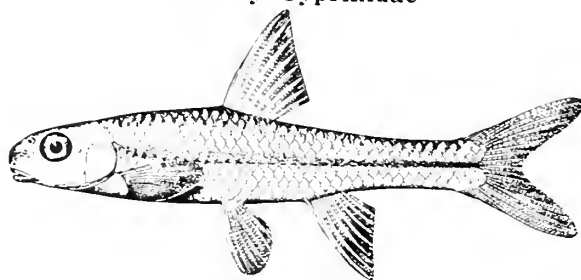
Compiler: C. R. Gilbert. October 1978.

Notropis amnis Hubbs and Greene
Pallid shiner

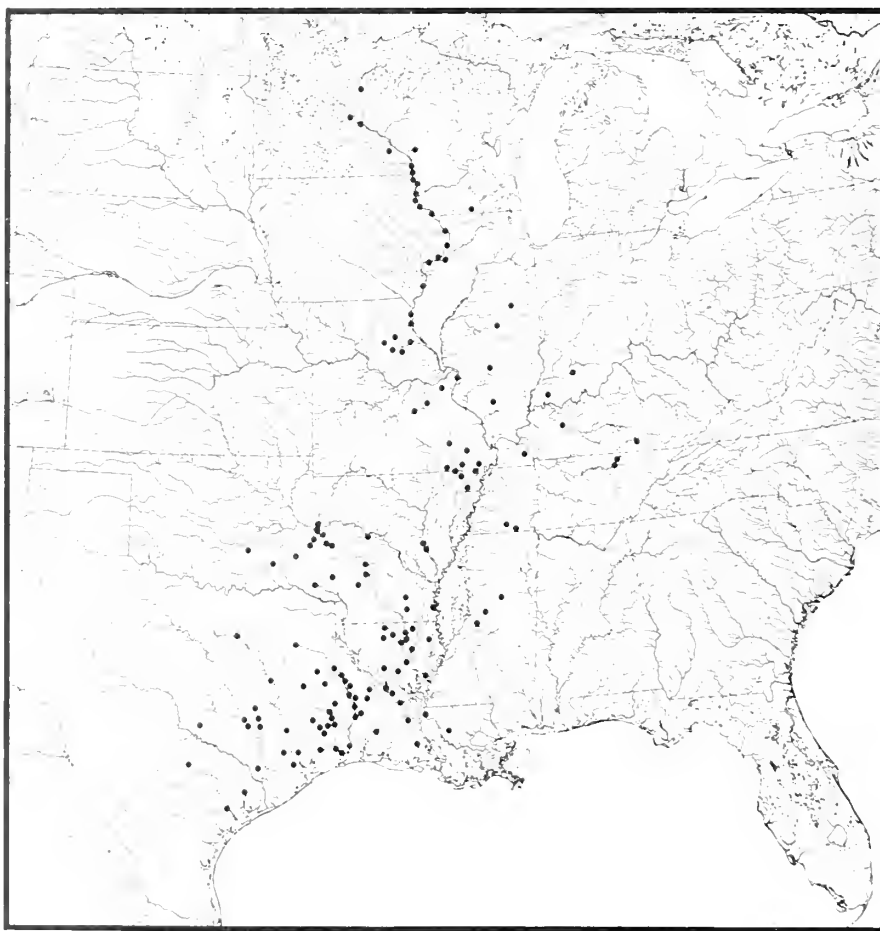
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Mississippi River, 1.7 km n of Prairie du Chien, Crawford Co., WS (Hubbs 1951. Occas. Pap. Mus. Zool. Univ. Mich. 530:1-31).

SYSTEMATICS: Clemmer (1971. Ph.D. diss., Tulane Univ.) studied systematics of this and closely related species *Hybopsis amblops*, *H. winchelli* (closest relative), *H. lineapunctata*, and *H. rubrifrons*. Hubbs (1951) recognized two subspecies, *N. a. amnis* and *N. a. pinnosa*, but this seems unwarranted as there is broad overlap in Mississippi Valley.



TX: Trinity River, Magnolia Point, ca. 50 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Mississippi River in WS and MN south to Amite River, LA, and west to Guadalupe River in TX. Prefers medium to large rivers and streams and quiet waters over sand-silty bottoms, often at end of sand and gravel bars.

ADULT SIZE: 70 mm SL maximum.

BIOLOGY: Populations greatly reduced or exterminated in northern parts of range (Pflieger 1975. *The Fishes of Missouri*). Intolerant of heavy siltation and pollutants. Breeds late winter and early spring in south. Ripe adults taken in AR in March. Males develop large breeding tubercles on head and snout. No data available on food habits.

Compiler: G. H. Clemmer, October 1979.

Notropis amoenus (Abbott)
Comely shiner

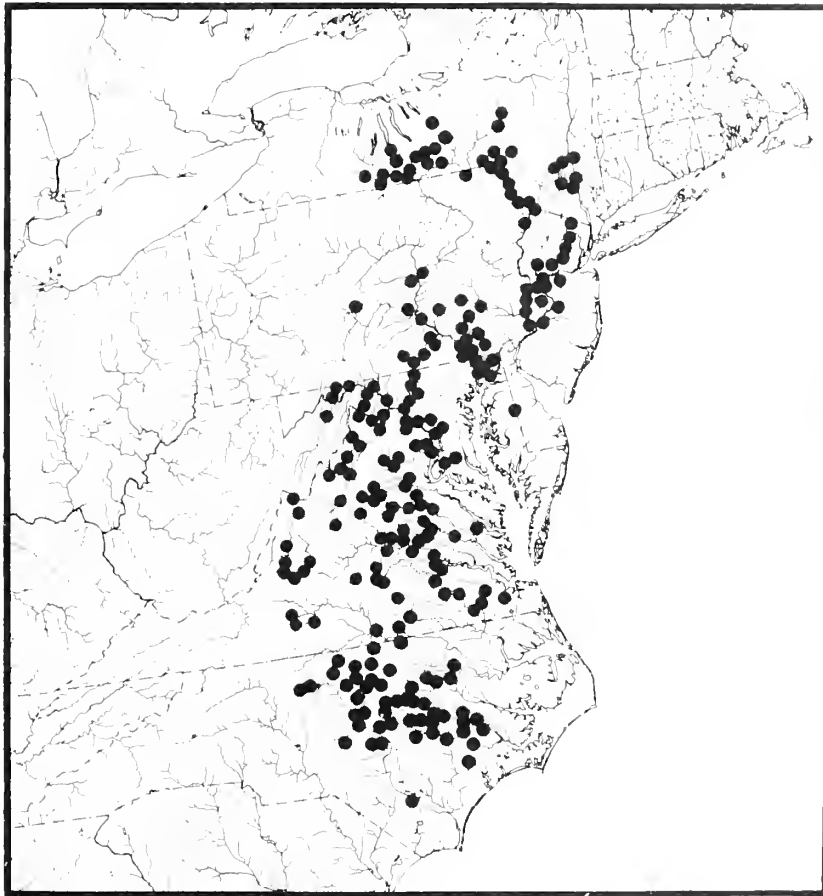
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Delaware and Raritan Canal, probably in Mercer Co., NJ (Abbott 1874. Am. Nat. 8:326-38).

SYSTEMATICS: Subgenus *Notropis*. Formerly thought closely related to *N. rubellus* and often misidentified as that species. Snelson (1968. Copeia: 776-802) reviewed systematics and considered it most closely related to *N. atherinoides*.



MD: Frederick Co., Broad Creek, Conowingo Lake, 67 mm SL (NCSM).



Map modified from Snelson 1968

DISTRIBUTION AND HABITAT: Upper Coastal Plain and Piedmont streams from Hudson and Susquehanna drainages in NY south through Cape Fear drainage in NC. One recent collection from Rocky Creek, Yadkin River system, Montgomery Co., NC. One old record from Seneca Lake, NY, in Lake Ontario drainage. Habitat variable, but usually found in medium- to large-size creeks and rivers, especially in channels. Current may vary from slow to quite fast; no apparent preference for bottom type or presence of vegetation. Common in preferred habitat.

ADULT SIZE: 50-75 mm SL, 87 mm SL maximum.

BIOLOGY: No definitive biological studies exist. Snelson (1968) summarized known information. Based on tuberculation, apparently spawns throughout summer with most reproduction occurring in July. A schooling, mid-water swimmer.

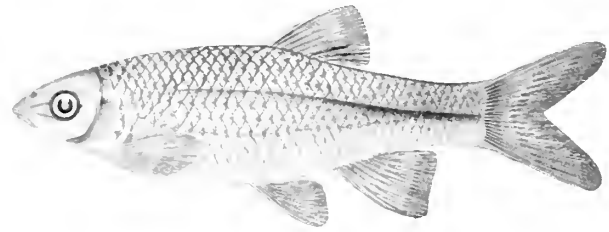
Compilers: F. F. Snelson, Jr. and C. R. Gilbert. September 1978.

Notropis analostanus (Girard)
Satinfin shiner

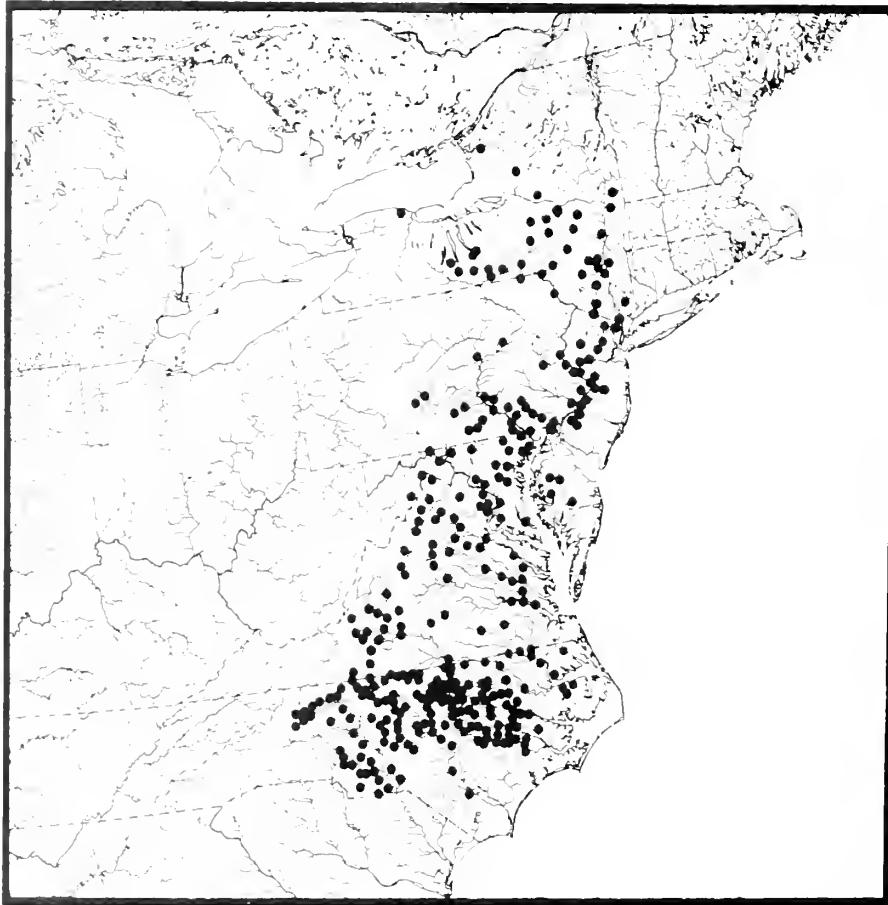
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rock Creek (tributary to Potomac River), Washington, DC (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:56-68).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1963. Copeia:511-28) recognized two subspecies, *N. a. analostanus* and *N. a. chloristius*, but these now usually regarded as distinct species (see 1970 and 1980 AFS checklists). Closely related to *N. whipplei* and is apparently Atlantic slope geminate of that species.



MD: Dorchester Co., Choptank River, 56 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Peedee River drainage, NC, north to lower Hudson River and southern Lake Ontario drainages, NY. Occurs sympatrically and syntopically with very similar *N. spilopterus*, from middle Potomac River drainage north to lower Hudson River and Lake Ontario drainages, NY. In moderately small to large, weedless streams with substrate ranging from sand to gravel and rubble. Occasionally reaches tidal portions of some large rivers. Common.

ADULT SIZE: 53-93 mm TL (males); 47-79 mm TL (females).

BIOLOGY: Stone (1940. Ph.D. diss., Cornell Univ.) studied biology and life history in NY. Some females live four years, but no

males of more than three years were found. Most mature at age I, but some at age II. Spawns diurnally late May to mid-August in NY, at 18-27°C. Probably spawns twice a season. Eggs attached to branches, stumps, and logs. No care of eggs or young, but male guards nest territory. Insects, particularly Diptera or Ephemeroptera, are principal food. Stout (1975. Am. Midl. Nat. 94:296-325) discussed sound communication during reproductive behavior, and Gale and Buyhak (1978. Trans. Am. Fish. Soc. 107:460-63) reported spawning frequency and fecundity.

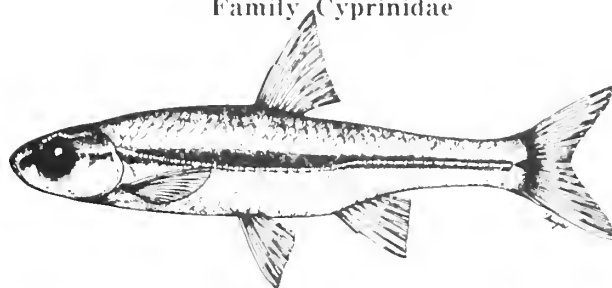
Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

***Notropis anogenus* Forbes**
Pugnose shiner

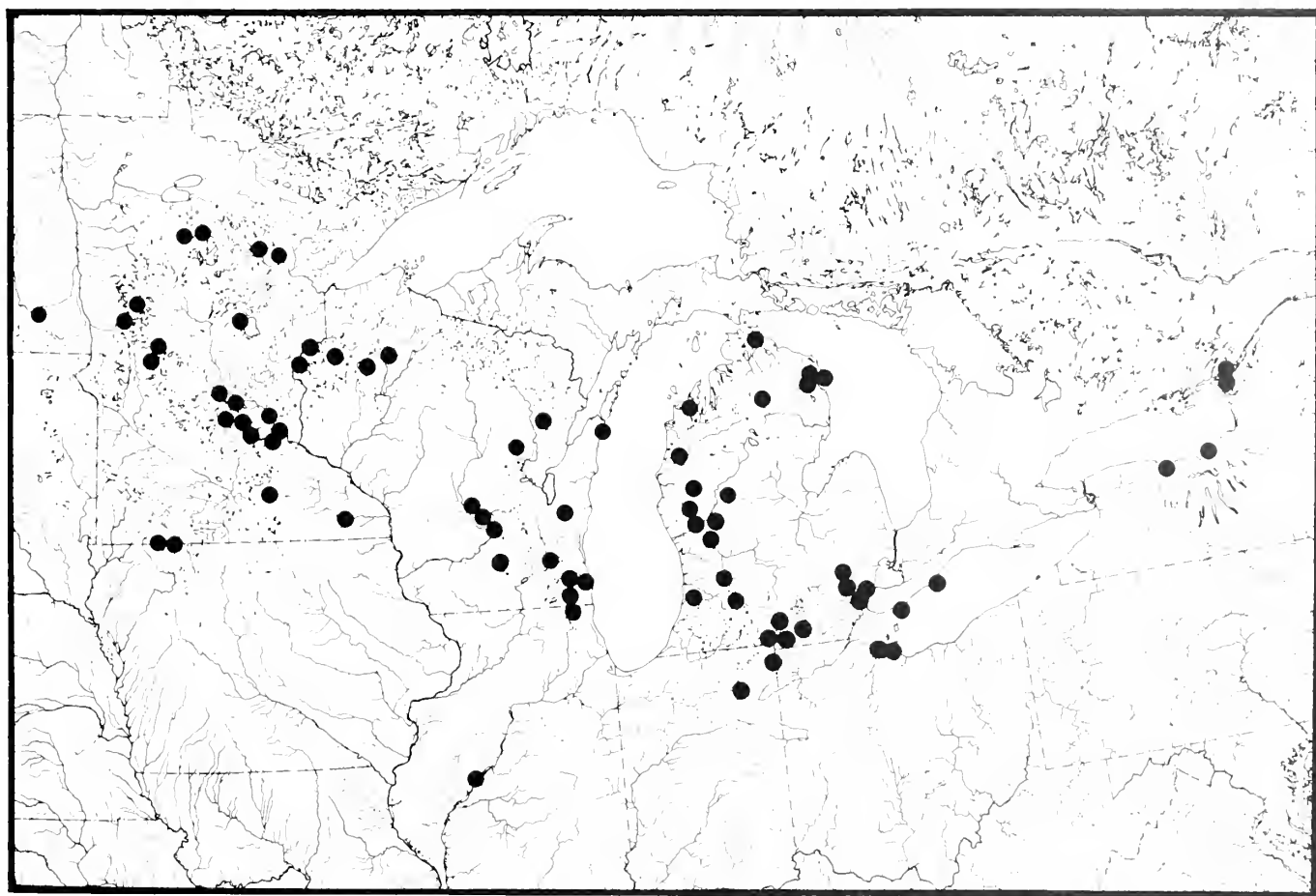
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Fox River, McHenry, McHenry Co., IL (Forbes 1885. Bull. Ill. Lab. Nat. Hist. 2:135-39).

SYSTEMATICS: Bailey (1959. Copeia:119-23) reviewed systematics and distribution and suggested possible relationship to *N. topeka* and perhaps also to *N. ortenburgeri* and *N. bifrenatus*.



ON: Kent Co., Morpeth
Rondeau Provincial Park, 35
mm SL (NMC).



Map modified from Bailey 1959

DISTRIBUTION AND HABITAT: Western NY and eastern ON west to southeastern ND; in Great Lakes (excluding Lake Superior), upper Mississippi River, and extreme upper (southern) Red River of North drainage. Confined to clear, heavily vegetated glacial lakes and streams. Generally rare, and often missing from seemingly favorable habitat within range.

BIOLOGY: No biological study published. Spawns in spring, probably in June, in ON. Very small, upturned mouth presumably causes restriction of diet to microscopic animals.

ADULT SIZE: ca. 45 mm SL.

Compiler: C. R. Gilbert. August 1978.

Notropis ardens (Cope)
Rosefin shiner

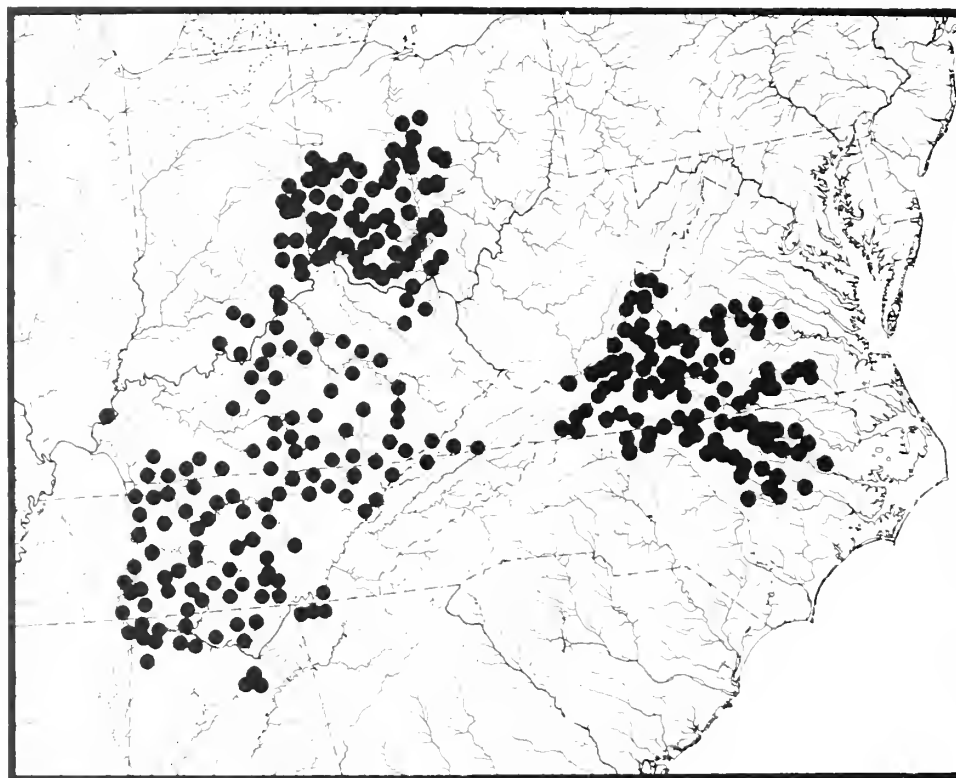
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Headwaters of Roanoke River, Montgomery Co., VA (Cope in Günther 1868. *Catalogue of the Fishes in the British Museum* 7:1-512).

SYSTEMATICS: Subgenus *Lythrurus*, most closely related to *N. lirus*. Geographically variable in several characters, but subspecies *N. a. fasciolaris* and *N. a. matutinus* probably do not merit recognition (Snelson 1972. Bull. Fla. State Mus. Biol. Sci. 17:1-92; Snelson unpubl.).



AL: Madison Co., Tennessee River system, male, 57 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Atlantic slope; common in upland regions from York drainage, VA, south through Neuse drainage, NC. One record from Cape Fear drainage, NC. Questionable literature records from Shenandoah drainage, VA; literature record from Savannah drainage, SC, based on misidentification. In Ohio basin, widespread in middle portion of Tennessee drainage and throughout Cumberland drainage. Upstream in Ohio River tributaries through Scioto River system, OH. Also in New (Kanawha) River drainage, VA. Rare in upper Tennessee drainage; headwaters of Black Warrior River (Mobile Bay drainage), AL; and south-eastern IL. Inhabitant of small to medium-

sized upland streams with moderate flow and usually gravel and rubble bottoms. Typically common.

ADULT SIZE: 45-70 mm SL.

BIOLOGY: Spawns in spring and early summer, often over nests of chubs (Raney 1947. Zoologica 32:125-32). Male larger than female. Complementary distribution with *N. umbratilis* in Ohio River basin suggests competitive relationship. The two occasionally hybridize.

Compiler: F. F. Snelson, Jr. September 1978.

Notropis ariommus (Cope)
Popeye shiner

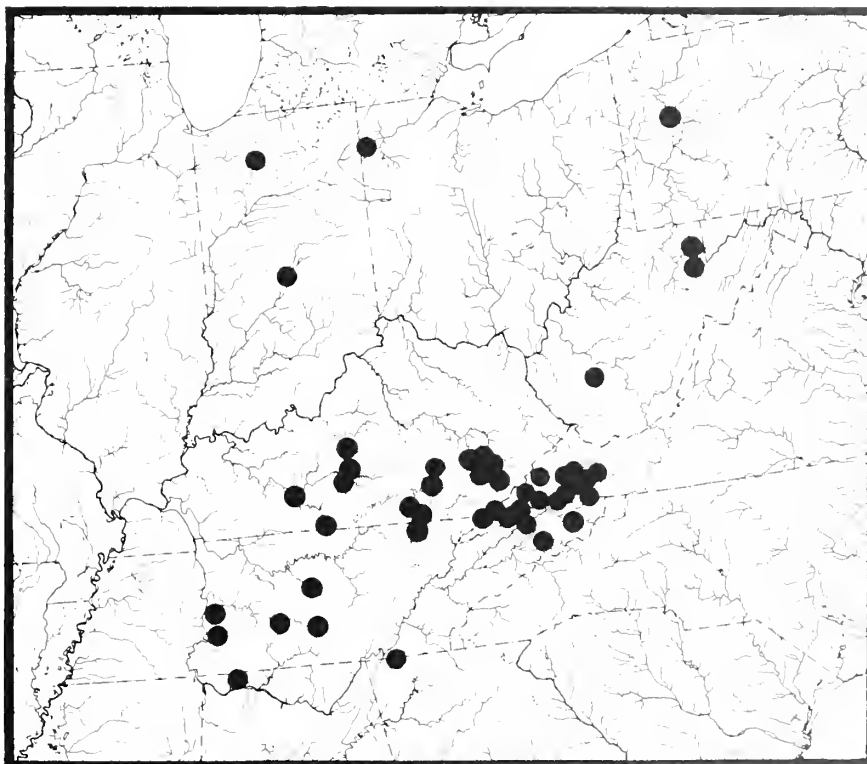
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: White River, near Indianapolis, Marion Co., IN (Cope 1868. Proc. Acad. Nat. Sci. Phila. 19:156-66).



SYSTEMATICS: Subgenus undetermined. Gilbert (1969. Copeia:474-92) reviewed systematics of species. From 1939-1969 was regarded as only subspecifically distinct from *N. telescopus* and many literature records of *N. "ariommus"* during this period actually refer to *N. telescopus*.

KY: Rockcastle Co., Rockcastle River, 64 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Tennessee River drainage in AL and GA north to upper Wabash River drainage in IN, Lake Erie drainage in OH, and upper Ohio basin in PA and WV. Found in relatively clear, flowing waters of large creeks and small rivers, where it is closely associated with gravel substrate. Restriction to this type of bottom probably accounts for its present spotty distribution and extirpation from many places where formerly present. Seldom very common.

ADULT SIZE: 45-75 mm SL.

BIOLOGY: No specific ecological or life history studies have been conducted on this species. Gilbert (1969) summarized available information.

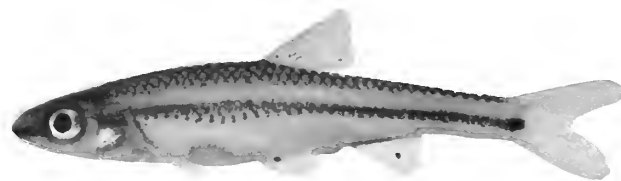
Compiler: C. R. Gilbert. May 1978.

Notropis asperifrons Suttkus
and Raney
Burrhead shiner

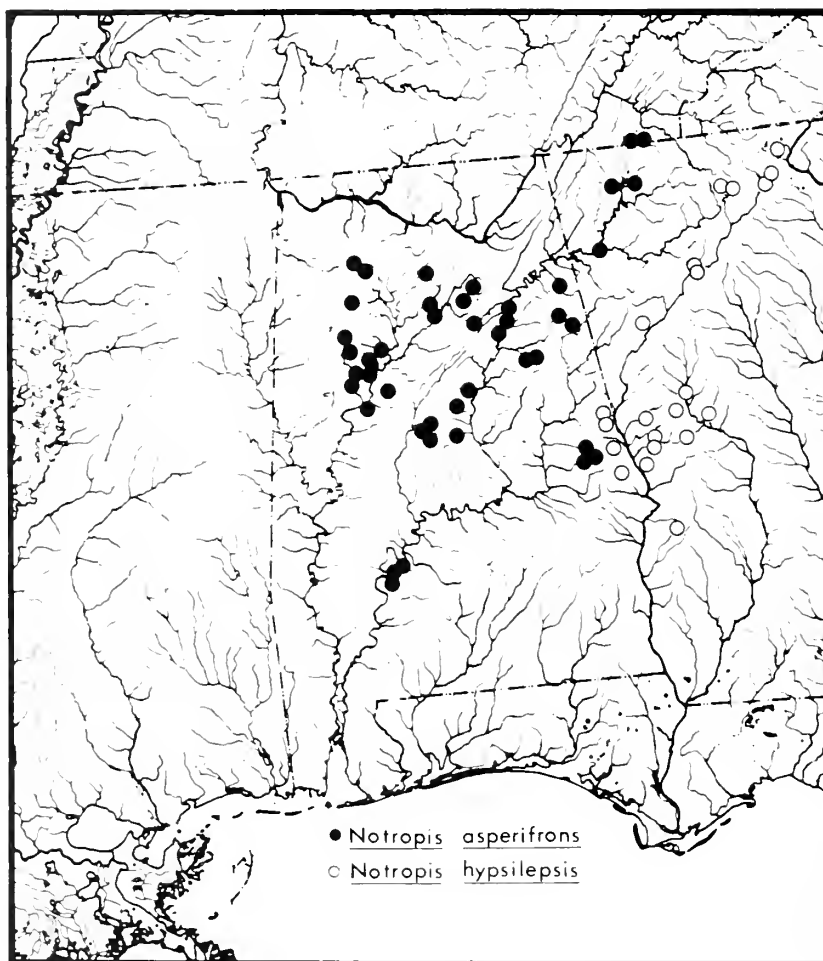
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Holly Creek, Ramhurst, Murray Co., GA (Suttkus and Raney 1955. Tulane Stud. Zool. 3:3-33).

SYSTEMATICS: Swift (1970. Ph.D. diss., Florida State Univ.) studied systematics. Member of the *N. texanus* species group, which includes *N. chalybaeus*, *N. hypsilepis*, and *N. petersoni*. Slight differentiation between Tombigbee and Coosa-Cahaba populations. (Swift 1970; Suttkus and Raney 1955).



AL: Jefferson Co., Crooked Creek, 40 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Alabama and Tombigbee river systems (Mobile Bay drainage), mostly above Fall Line. Small to medium-sized clear streams, usually on or near bottom (Swift 1970; Suttkus and Raney 1955).

BIOLOGY: Little known. Morphology suggests benthic, microphagus habit. Breeds April to June, based on museum collections (Suttkus and Raney 1955; Swift 1970).

ADULT SIZE: 45-60 mm SL.

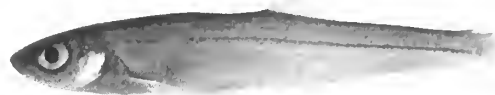
Compiler: C. C. Swift. January 1979.

Notropis atherinoides Rafinesque
Emerald shiner

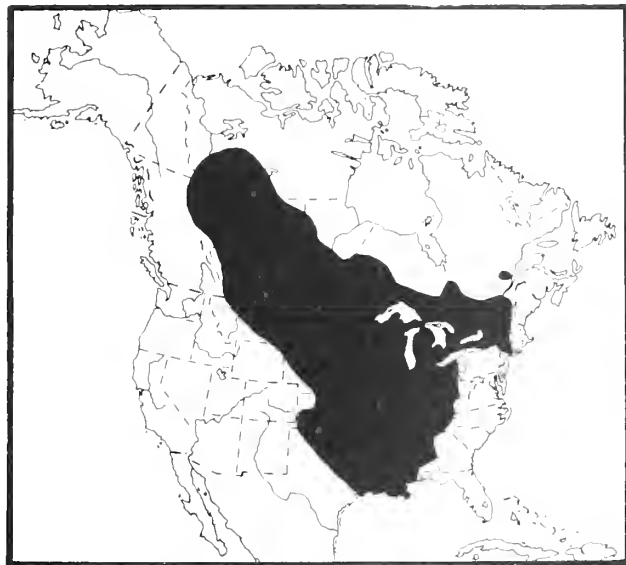
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: "Lake Erie" (Rafinesque 1818. Am. Monthly Mag. Crit. Rev. 2:203-4).

SYSTEMATICS: Subgenus *Notropis*. Closest relatives include *N. amoenus*, *N. oxyrhynchus*, and *N. jemezianus*. Snelson (1968. Copeia:776-802) compared *N. amoenus* with *N. atherinoides* specimens from NY. Hubbs (1945. Copeia:13-22) considered *N. percobromus* distinct from *N. atherinoides*, based primarily on some pigment differences in area of sympatry in OK, but Bailey and Allum (1962. *Fishes of South Dakota*) considered this to have ecophenotypic basis. Bailey and Allum (1962) summarized vertebral and morphometric variation over a wide area, and Flittner (1964. Ph.D. diss., Univ. Michigan) and Resh et al. (1976. Bull. Southern Calif. Acad. Sci. 75:76-84) analyzed vertebral variation in Great Lakes and Ohio River drainages, respectively. Gilbert (1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104) found types of *N. percobromus* to be *N. rubellus*.



KY: McCreary Co., Big South Fork of Cumberland River, 70 mm SL (NCSM).



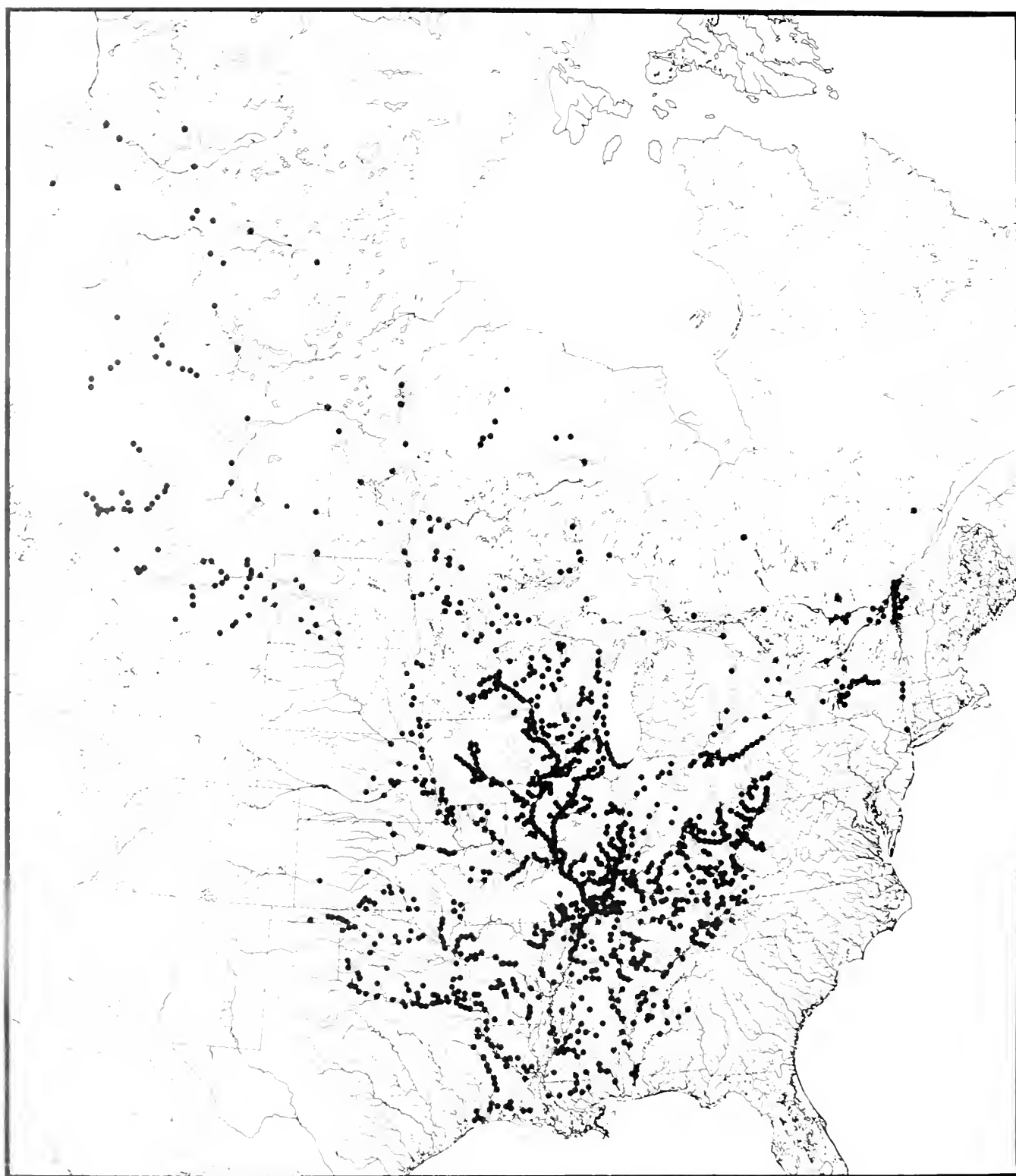
See map on next page

DISTRIBUTION AND HABITAT: Widely distributed, from Galveston Bay drainage, TX, east to Mobile Bay basin, AL, north (west of Appalachians) through Mississippi basin and St. Lawrence River drainage to Lake Champlain and QU, west through southern Canada to Great Slave Lake and Mackenzie River, NT, and south through AT, MT, ND, and SD to Red River drainage of northern TX. Restricted to large open rivers and lakes of varying turbidity, where it swims in large schools. Common to abundant.

BIOLOGY: Studies on biology and life history includes Adams and Hankinson (1928. Roosevelt Wild Life Ann. 1:235-548) (Oneida Lake, NY), Gray (1942. M.Sc. thesis, Ohio St. Univ.) (Lake Erie), Flittner (1964. Ph.D. diss., Univ. Michigan) (Great Lakes), Fuchs (1967. Trans. Am. Fish. Soc. 96:247-56) (Lewis and Clark Lake, SD), and Campbell and MacCrimmon (1970. J. Fish Biol. 2:239-73) (Lake Simcoe, Canada). Lives at least until age II. Flittner (1964) noted protracted summer spawning period, over wide range of temperatures, in MI. In IA, females taken in mid-July had completed spawning. Ripe females taken in IL from mid-May to early June. Minckley (1963. Wildl. Monogr. 11: 1-124) reported food as mostly terrestrial insects in summer and amphipods, mayfly naiads, and caddis worms in winter. Important forage fish in large rivers and lakes.

ADULT SIZE: 102 mm TL maximum.

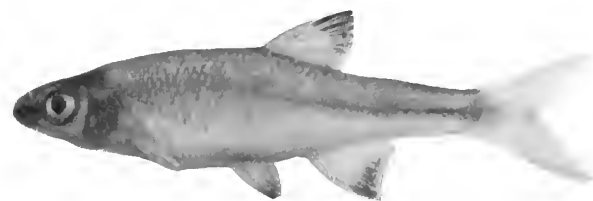
Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.



Distribution of emerald shiner, *Notropis atherinoides*

***Notropis atrapiculus* Snelson**
Blacktip shiner

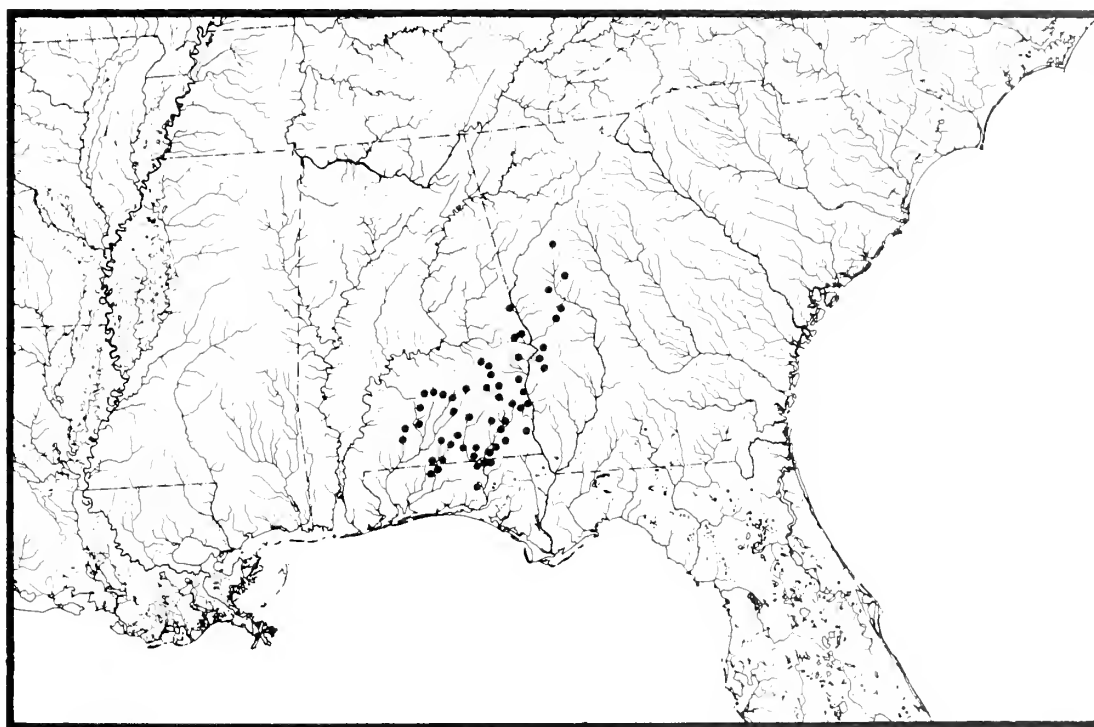
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: Sikes Creek, 5.6 km ene of Clio, Choctawhatchee drainage, Barbour Co., AL (Snelson 1972. Bull. Fla. State Mus. Biol. Sci. 17:1-92).

SYSTEMATICS: Subgenus *Lythrurus*. Closely related to, and morphologically intermediate between, *N. b. bellus* and *N. roseipinnis*. Pre-1972 records of *N. roseipinnis* from FL, GA, and southeastern AL based on this species. No subspecies (Snelson 1972).

AL: Bullock Co., Old Town Creek, male, 51 mm SL (F. F. Snelson).



Map from Snelson 1972

DISTRIBUTION AND HABITAT: Escambia, Yellow, Choctawhatchee, and Apalachicola drainages on eastern Gulf slope. Above and below Fall Line in Apalachicola drainage, elsewhere limited to Coastal Plain. In Old Town Creek (Bullock Co., AL) of Tallapoosa River system as result of manmade diversion of upper Conecuh River. Occupies small to medium-sized streams, usually composed of pools alternating with short stretches of riffle or run. Stream gradients moderate, bottoms usually sand. Locally common; populations scattered.

ADULT SIZE: 30-51 mm SL.

BIOLOGY: Little known. Based on tuberculation, appears to be early summer spawner. No sexual dimorphism in adult size.

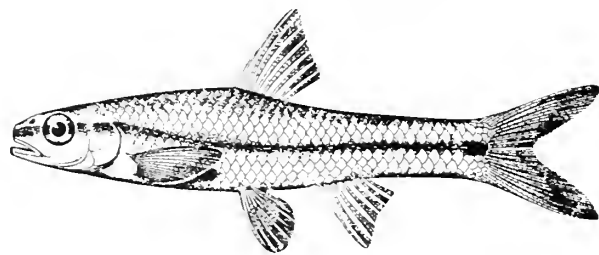
Compiler: F. F. Snelson, Jr. September 1978.

***Notropis atrocaudalis* Evermann**
Blackspot shiner

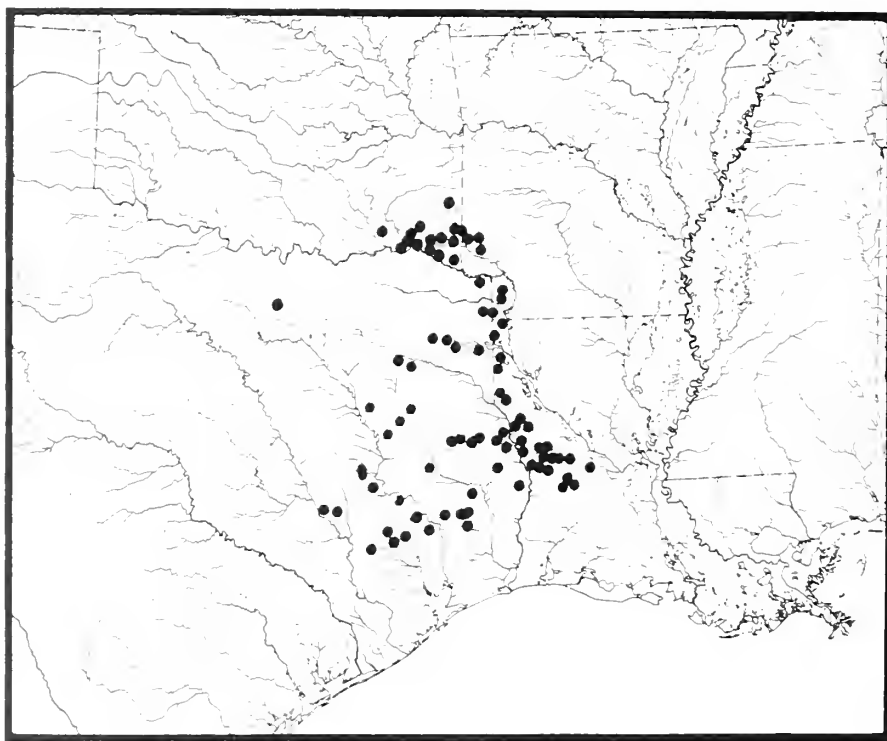
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Neches River, ca. 22.5 km e of Palestine, Anderson Co., TX (at Palestine and Rusk railroad bridge) (Evermann 1892. Bull. U.S. Fish Comm. [1891] 11: 61-90).

SYSTEMATICS: No definitive systematic study published, and precise systematic relationships not clear. Hubbs and Ortenburger (1929. Univ. Okla. Bull. 1: 45-112) confused species with *N. amnis*, and it was often considered subspecies of *N. heterolepis*, to which it may or may not be closely related. Hubbs (1951. Occas. Pap. Mus. Zool. Univ. Mich. 530: 1-30) first properly diagnosed *N. atrocaudalis* and pointed out specific distinctness.



TX: Neches River, near Palestine (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Lower Brazos River drainage of eastern TX east to Calcasieu River drainage of southwestern LA and Red River drainage of southeastern OK, southwestern AR, and northwestern LA. Inhabits small to moderate-sized, shallow flowing streams with bottom ranging from sand, gravel, and mud to rubble and occasionally boulders. Often fairly common.

ADULT SIZE: 76 mm TL (ca. 62 mm SL) maximum.

BIOLOGY: Nothing known.

Compiler: C. R. Gilbert. October 1978.

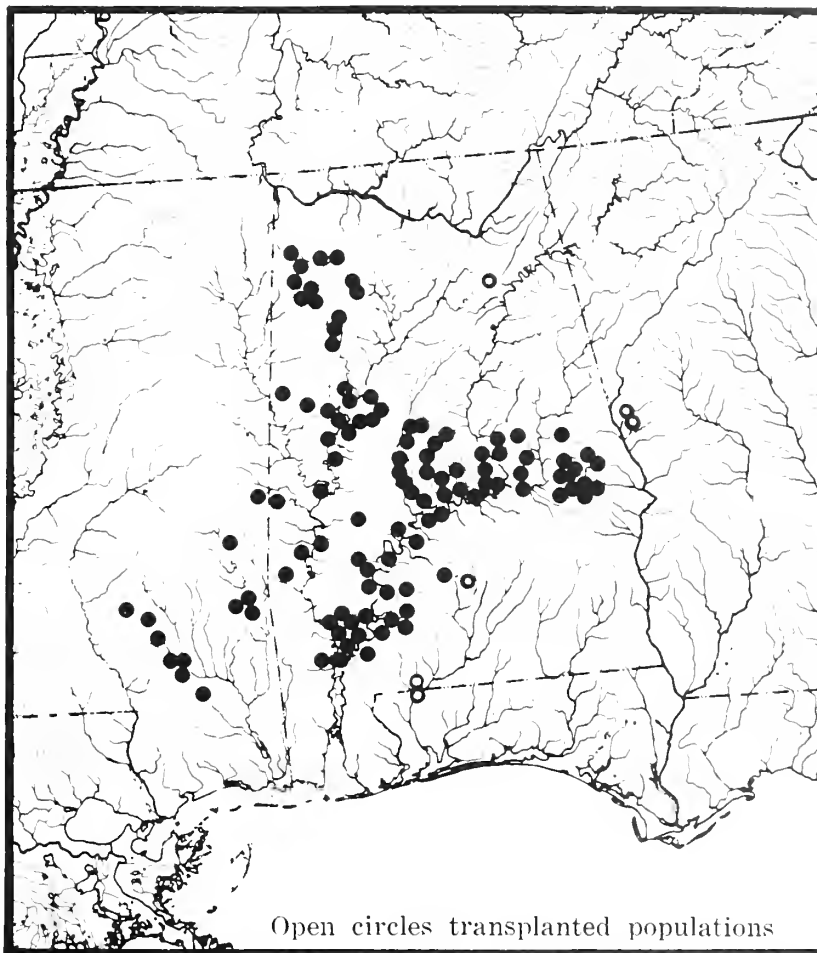
***Notropis baileyi* Suttkus and Raney**
Rough shiner

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Sawacklahatchee Creek, tributary to Tallapoosa River, 2.7 km w of Society Hill, on U.S. hwy. 80, Macon Co., AL (Suttkus and Raney 1955. Tulane Stud. Zool. 2:71-86).

SYSTEMATICS: Subgenus *Hydrophlox*. Swift (1970. Ph.D. diss., Florida State Univ.) reviewed systematics and included *N. baileyi* in species group with *N. chiliticus*, *N. chlorocephalus*, *N. lutipinnis*, and *N. rubricroceus*.

AL: Pickens Co., Coal Fire Creek, 54 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Mostly in upper Coastal Plain and Piedmont areas from Leaf and Chickasawhay rivers (Pascagoula River drainage), MS, east through Mobile Bay drainage of AL (to lower Tallapoosa River system). Also in Escambia River drainage, AL and FL, where possibly introduced. Gilbert (1969. M.Sci. thesis, Auburn Univ.) and Dahlberg and Scott (1971. Ga. Acad. Sci. 29:1-64) reported introduced population in Chattahoochee River system of GA. In wooded, moderate to high gradient streams, usually 1.5-3.0 m wide, with moderate flow. Substrate usually sand and gravel, and submergent aquatic vegetation normally absent. Usually common.

ADULT SIZE: 75 mm SL maximum.

BIOLOGY: Mathur and Ramsey (1974a. Trans. Am. Fish. Soc. 103:88-93; 1974b. Am. Midl. Nat. 92:84-93) published on reproduction and food habits. Has extended spawning period (May to early October), with peak in early or mid-June. Feeds on aquatic insect larvae and terrestrial insects. Life span usually two years. Hybridizes with *N. chrosomus* in White Oak Creek, Dallas Co.; and Pigeon Creek, Clarke Co., AL (Swift 1970).

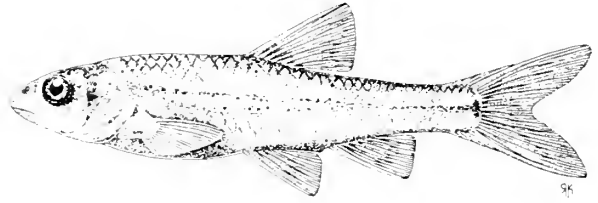
Compilers: C. C. Swift and C. R. Gilbert.
August 1978.

Notropis bairdi Hubbs and
Ortenburger
Red River shiner

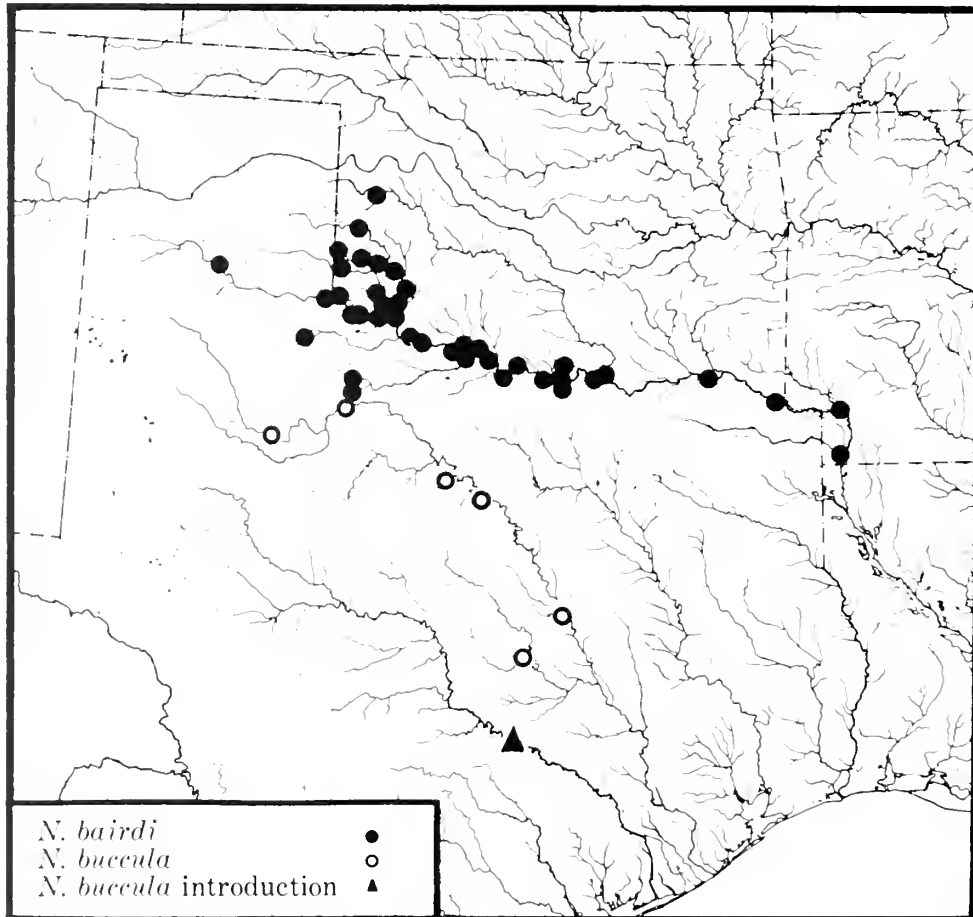
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Red River, 10-14.5 km sw of Hollis, Harmon Co., OK (Hubbs and Ortenburger 1929, Publ. Univ. Okla. Biol. Surv. 1:17-43).

SYSTEMATICS: Very closely related to *N. buccula*, which is endemic to adjacent Brazos River drainage, TX. Detailed comparison included in Cross' (1953, Texas J. Sci. 5:252-59) original description of *N. buccula*. These species, with *N. girardi* (of Arkansas River drainage), form close group whose precise relationships to other *Notropis* species are not entirely clear.



(NCSM)



DISTRIBUTION AND HABITAT: Endemic to Red River drainage of northern TX, southern OK, and extreme southwestern AR. Extremely abundant in upper parts of Red drainage down to just above mouth of Washita River in south-central OK; decreases markedly in abundance below this point, with downstream records sporadic and apparently based on scattered individuals that have drifted, or been washed, downstream. A distributional anomaly may be noted with regard to record from upper Washita River, Roger Mills Co., OK. One would be inclined to suspect either a transposition of locality data or misidentification of specimens of closely related *N. girardi* (which occurs in the geographically adjacent South

Canadian River) were not the series in question included among paratype material. Typically in turbid waters of broad, shallow channels of main stream, over bottom mostly of silt and shifting sand.

ADULT SIZE: ca. 30-50 mm SL, 64 mm SL maximum.

BIOLOGY: Although biology and life history have not been studied, they presumably are very similar to those of *N. girardi* (Moore 1944, Copeia: 209-14). (See account of that species for details). Food not recorded, but presumably small aquatic invertebrates.

Compiler: C. R. Gilbert. October 1978.

Notropis bellus (Hay)
Pretty shiner

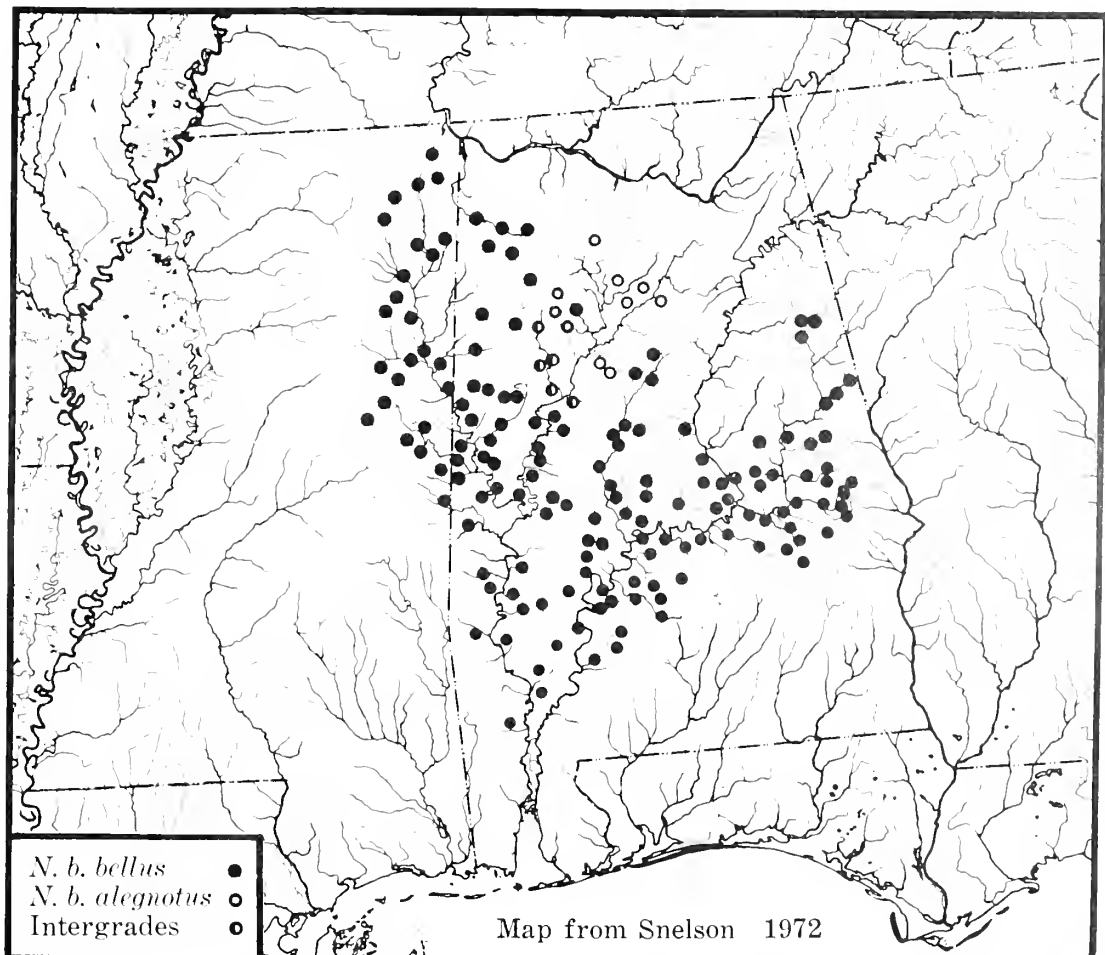
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Catawba Creek and tributaries at Artesia, Tombigbee River drainage, Lowndes Co., MS (Hay 1881. Proc. U. S. Natl. Mus. [1880] 3:488-515).

SYSTEMATICS: Subgenus *Lythrurus*. Closely related to *N. roseipinnis* and *N. atrapiculus*. Two well-defined subspecies recognized, *N. b. alegnotus* and *N. b. bellus*. Snelson (1972. Bull. Fla. State Mus. Biol. Sci. 17: 1-92) reviewed systematics of this and closely related species.



AL: Macon Co., tributary Sawachlahatchee Creek, male, 52 mm SL (F. F. Snelson).



DISTRIBUTION AND HABITAT: Widespread over middle and upper Coastal Plain in all drainage systems of Mobile Bay basin, AL and MS. In Bear and Yellow creeks, Tennessee River tributaries, which it apparently reached as result of stream capture (Wall 1968. M.Sc. thesis, Univ. Alabama). *Notropis b. alegnotus* occurs above Fall Line in Black Warrior River system. Intergrades occur at Fall Line near Tuscaloosa, AL. Inhabits small to moderately large streams of low to moderate gradients. Usually over sand, silt, or clay bottoms; rarely over gravel or bedrock. Usually avoids lower Coastal

Plain. *Notropis b. bellus* common below Fall Line; *N. b. alegnotus* uncommon with scattered populations.

ADULT SIZE: 40-55 mm SL.

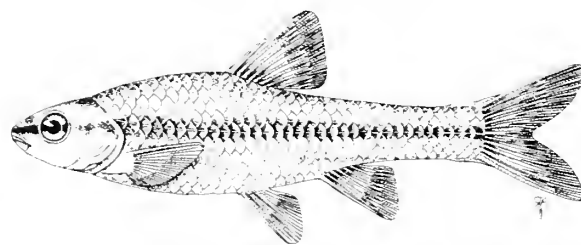
BIOLOGY: Little known. Based on tuberculation, appears to be late spring-early summer spawner. Snelson (1972) observed apparent prespawning aggregations and activity in *N. b. bellus* over nests of *Lepomis megalogotis*. Adult males larger than females (Snelson 1972).

Compiler: F. F. Snelson, Jr. September 1978.

***Notropis bifrenatus* (Cope)**
Bridle shiner

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributary to Schuylkill River, Conshohocken, Montgomery Co., PA (Cope 1869. Trans. Am. Philos. Soc. 13:351-99).



MD: Harford Co., Swan Creek,
39 mm SL (NCSM).

SYSTEMATICS: Harrington (1955. Copeia: 267-90) reviewed osteology and Jenkins and Zorach (1970. Chesapeake Sci. 11:174-82) considered systematics and zoogeography. Systematic relationships uncertain, but based on external morphological similarities and nature of distribution patterns, *N. heterodon* may be closest relative.



DISTRIBUTION AND HABITAT: St. Lawrence River drainage of southern QU south from extreme southern ME to Neuse River drainage of northeastern NC, disjunct from next closest area of occurrence in Chowan River drainage of southeastern VA. Habitat ranges from warm-water small streams and ponds to large lakes and rivers, where usually found over mud, silt, or detritus in slack-water side areas with moderate to abundant vegetation.

ADULT SIZE: 25-50 mm SL.

BIOLOGY: Harrington (1947a. Copeia:97-102; 1947b. Copeia:186-92; 1948 Am. Midl.

Nat. 39:83-92; 1950. Copeia:304-11; 1951. Copeia:85-86) discussed various aspects of ecology and life history, based mostly on studies in NY and NH. This information summarized by Jenkins and Zorach (1970), with addition of new data. Breeding usually occurs in May and June in NY, but may extend into August. Spawning occurs in still, shallow water near shore where heavy vegetation is present. Food consists mostly of small invertebrates, but plant material is occasionally taken and may comprise up to 6% of food by volume.

Compiler: C. R. Gilbert. August 1978.

***Notropis blennioides* (Girard)**
River shiner

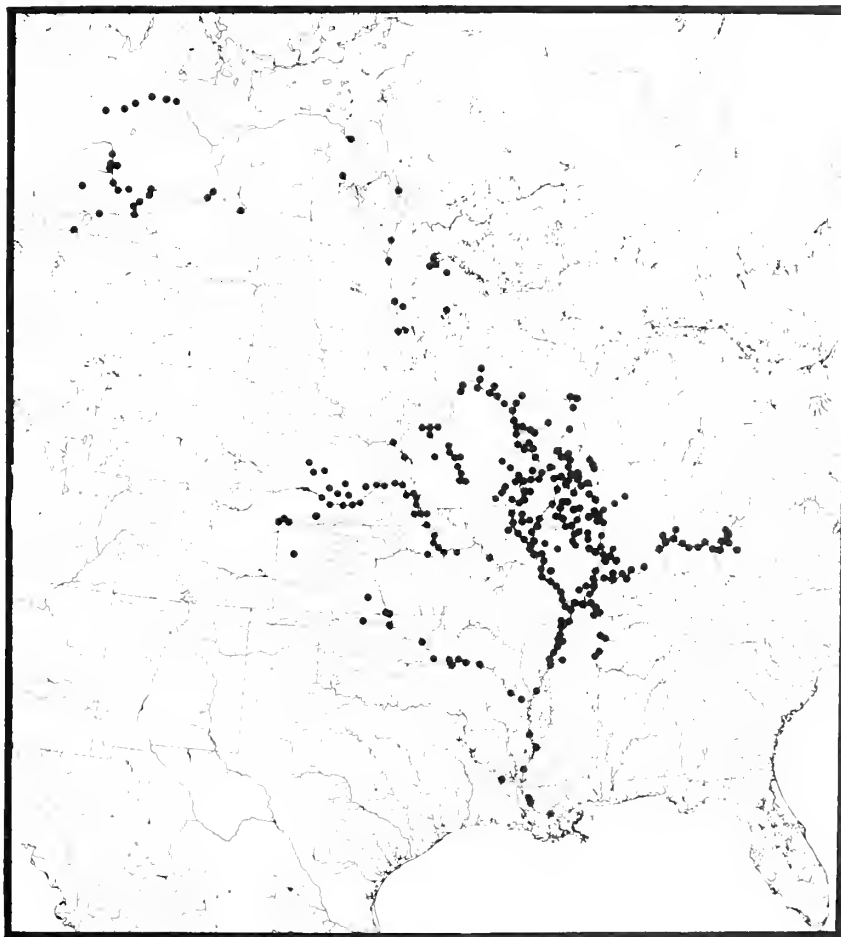
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Arkansas River near Fort Smith, AR (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Subgenus *Alburnops*. No definitive systematic study published. Suttkus and Clemmer (1968. Tulane Stud. Zool. Bot. 15:18-39) concluded it is most closely related to *N. edwarddracyni*. May also be closely related to *N. potteri*, but Suttkus and Clemmer (1968) hypothesized that morphological similarities may be due to evolutionary convergence.



MO: Lewis Co., Mississippi
River at Canton, 60 mm
SL (Mo. Dept. Cons.).



DISTRIBUTION AND HABITAT: Hudson bay drainage from AT to MB, south through Mississippi River basin to TX, LA, and MS. Absent from Missouri drainage above mouth of Platte River. Enters Great Lakes drainage only in Lake Winnebago (upper Fox River system), WI. Restricted to largest rivers and lower parts of main tributaries, in water of varying clarity (usually turbid) over substrate of silt, sand, and gravel, usually common in preferred habitat.

ADULT SIZE: 105 mm SL maximum.

BIOLOGY: Trautman (1957. *The Fishes of Ohio*) summarized what little is known regarding biology, and Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) summarized age-growth data. Spawns in late July and August in IA and throughout summer to late August in OH, usually over sand and gravel bars. May not live more than two years.

Compiler: C. R. Gilbert. August 1978.

Notropis boops Gilbert
Bigeye shiner

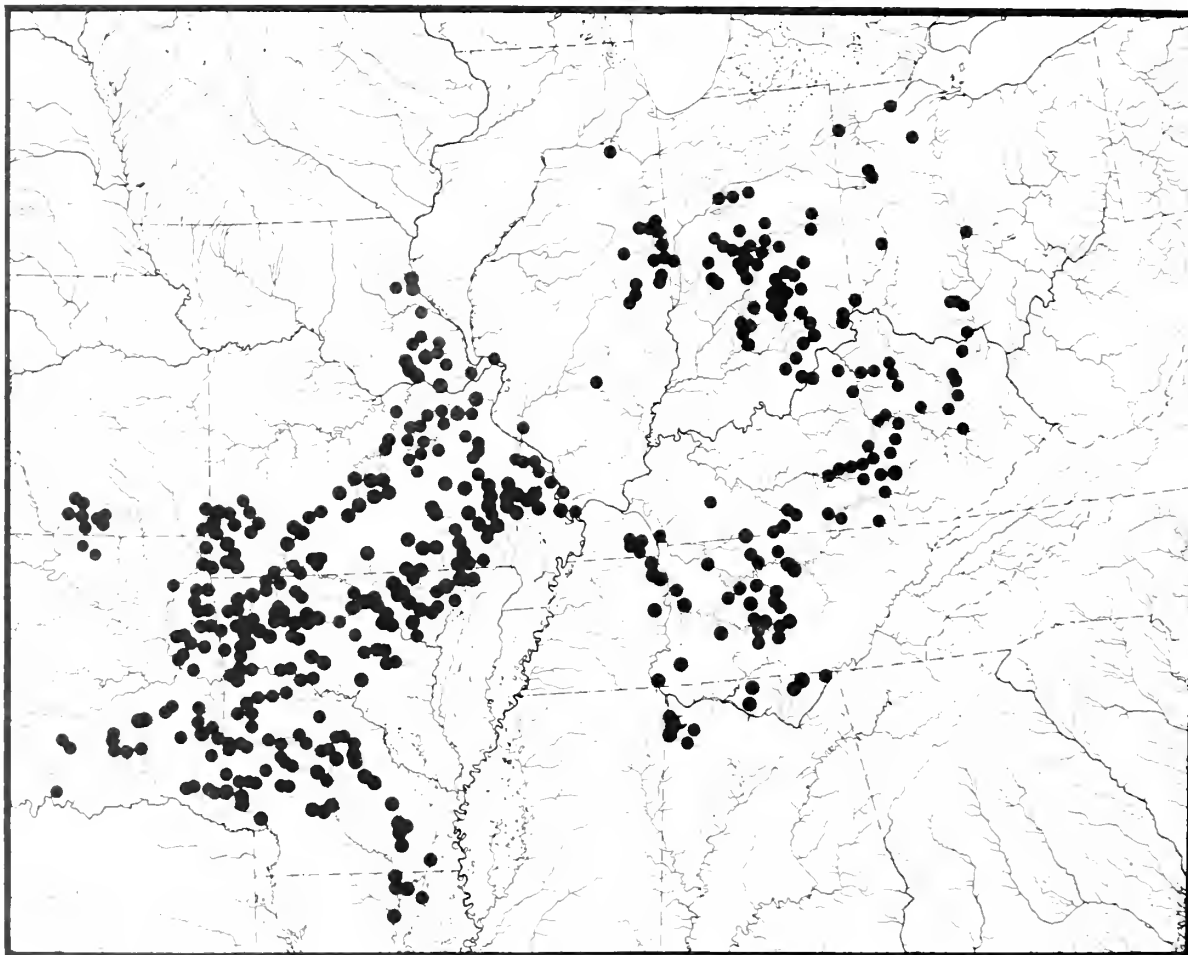
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Salt Creek, Brown Co., IN, and Flat Rock Creek, Rush Co., IN; not yet specifically restricted (Gilbert 1884. Proc. U. S. Natl. Mus. 7:199-205).

SYSTEMATICS: Subgenus not defined. No comprehensive systematic review of this species has been published.



AR: Polk Co., Cossatot River,
54 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Mostly in upland areas east and west of Mississippi River. East from Tennessee River drainage north to upper Wabash and western Lake Erie drainages. West from eastern and southern MO south to northern LA and west to KS and OK. Possible relict population in southwestern OK (Comanche Co.), not indicated on map since specimens are not available. In moderately clear streams with large, permanent pools over bottom of clear sand, gravel, or rock. Generally common except in north where most populations have been extirpated.

ADULT SIZE: 30-66 mm TL.

BIOLOGY: No specific ecological or life history studies have been conducted. Known information summarized by Pflieger (1975. *The Fishes of Missouri*).

Compiler: C. R. Gilbert. April 1978.

Notropis braytoni Jordan and
Evermann
Tamaulipas shiner

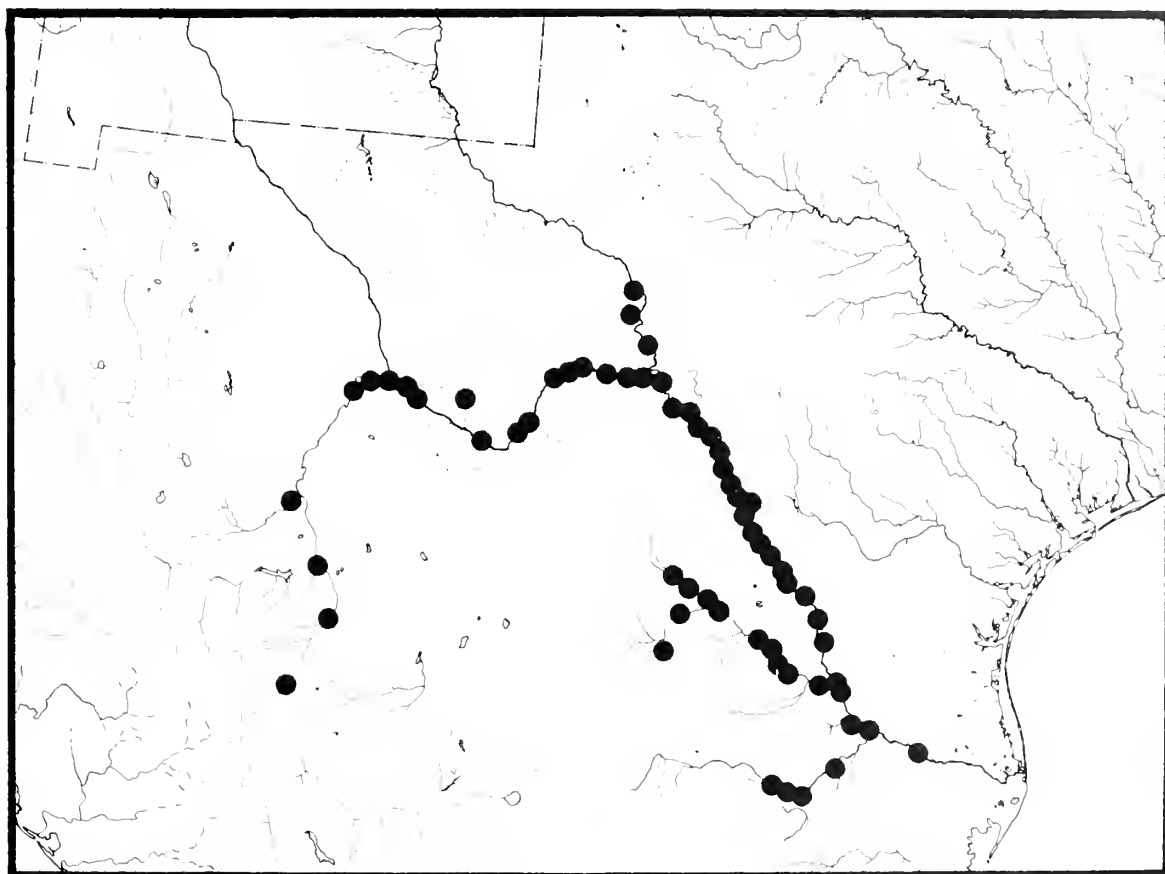
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio Monterrey (tributary to Rio San Juan), Cadereyta, Nuevo Leon, Mexico (Jordan and Evermann 1896. Bull. U. S. Natl. Mus. 47:1-1240).

SYSTEMATICS: Precise relationships to other *Notropis* species not determined. Hubbs and Hubbs (1958. Copeia : 297-307) noted morphological similarities to *N. saladonis*. No study published on infraspecific variation.



TX: Val Verde Co., Pecos River,
41 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to Rio Grande drainage in TX and Mexico, from near mouth of Rio Grande upstream to mouth of Rio Conchos. Inhabits major tributaries for varying distances (Rio San Juan, Rio Salado, and Rio Conchos in Mexico; Pecos River in TX). Former occurrence farther upstream in Pecos River and Rio Grande not documented. Koster (1957. *Guide to the Fishes of New Mexico*) did not record it from NM, nor Hubbs et al. (1977. Symposium on importance, preservation, and management of riparian habitat, Tucson, AZ, 91-97) from Rio Grande above mouth of Rio Conchos. However, irrigation practices which have severely reduced water flow in

Rio Grande between El Paso and Presidio may be responsible for absence. Apparently common in Rio Grande since Robinson (1959. Copeia : 253-56) found it at virtually all stations sampled. Typically in large, open, weedless rivers or large creeks with rubble, gravel and sand bottom, often overlain with silt. Water clarity may vary from clear to turbid, depending upon amount of rainfall.

ADULT SIZE: Not determined. Attains at least 50 mm SL.

BIOLOGY: Not studied.

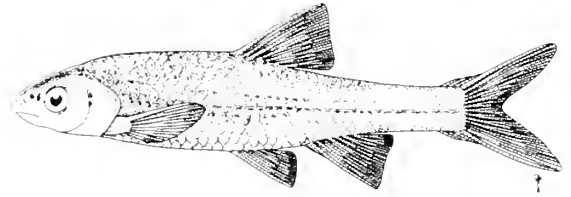
Compiler: C. R. Gilbert. October 1978.

Notropis buccula Cross
Smalleye shiner

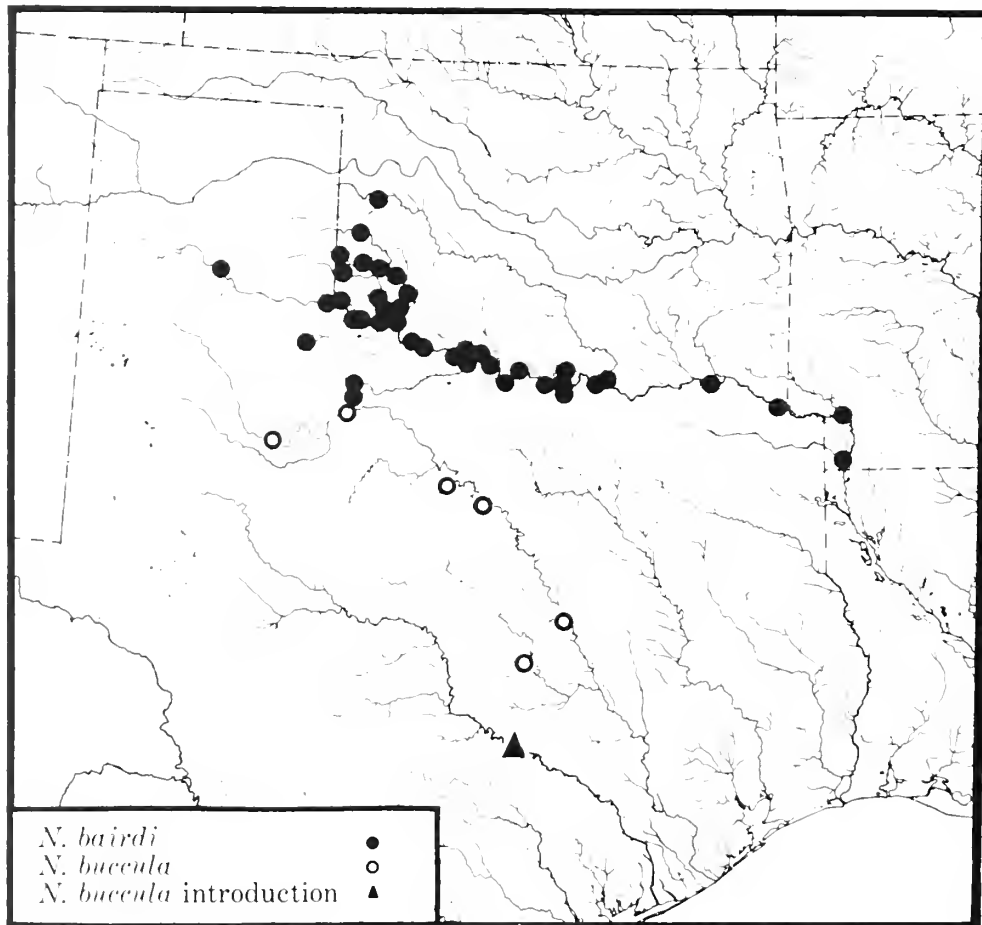
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Brazos River, ca. 11.3 km s of Mineral Wells, at U.S. hwy. 281, Palo Pinto Co., TX (Cross 1953. Tex. J. Sci. 5:252-59).

SYSTEMATICS: Very closely related to *N. bairdi* (of adjacent Red River drainage), and originally described as *N. bairdi buccula*. Upgraded, without comment, to full species status by Hubbs (1957. A checklist of Texas fresh-water fishes. Texas Game and Fish Comm. IF Ser. 3:1-11), where it remained in subsequent compilations (Bailey et al. 1960. Am. Fish. Soc. Spec. Publ. 2:1-102; 1970. Am. Fish. Soc. Spec. Publ. 6:1-150).



(NCSM)



DISTRIBUTION AND HABITAT: Upper two-thirds of Brazos River drainage, TX. Apparently introduced into adjacent Colorado River drainage. Typically in turbid waters of broad, sandy channels of main stream, over bottom consisting mostly of shifting sand. Probably common in preferred habitat.

ADULT SIZE: Unknown. Likely attains same size as closely related *N. bairdi*, in which adults range from 24-64 mm SL.

BIOLOGY: Not studied. Probably very similar to that of *N. girardi*. See remarks for that species.

Compiler: C. R. Gilbert. October 1978.

***Notropis buchanani* Meek**
Ghost shiner

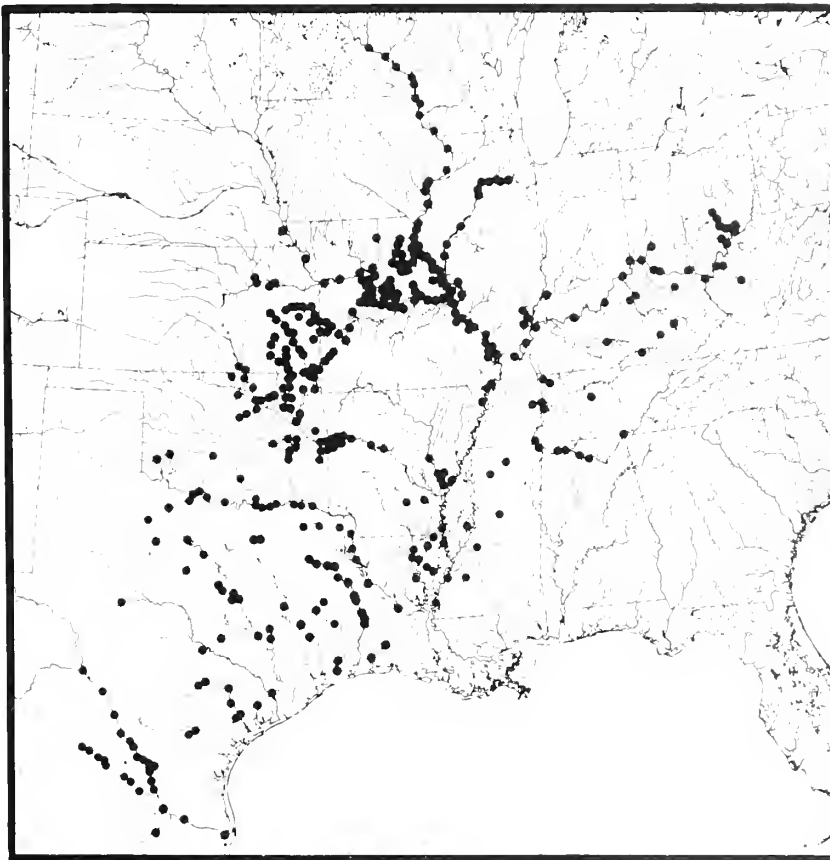
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Small creek near Poteau, Le Flore Co., OK (Meek 1896. Bull. U. S. Fish Comm. [1895] 15:341-49).

SYSTEMATICS: Hubbs and Greene (1928. Pap. Mich. Acad. Sci. Arts Lett. [1927] 8: 371-92) reduced *N. buchanani* to subspecies of *N. volucellus*. Bailey (in Harlan and Speaker 1951. *Iowa Fish and Fishing*) re-elevated it to full species status. Ramsey is studying systematics of this and closely related species. Some confusion attends type locality, which possibly should be Red River, at Arthur, TX, rather than locality listed above (Gilbert 1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104).



WV: Kanawha Co., Kanawha River, 35 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Lower Rio Grande drainage, in TX and Mexico (upstream to lower Pecos River), north into upper Mississippi River in MN and WS, and east in Ohio River basin to OH and WV. Apparently absent from Missouri River basin north of MO. Common in most suitable habitats west of Mississippi River, but apparently much more sporadic and localized east. Also appears more closely restricted to large rivers in northern and eastern parts of range. Characteristic of low-gradient sections of large creeks and rivers having moderate flow and moderately clear to turbid water. Inhabits larger pools and protected backwaters without noticeable current.

ADULT SIZE: ca. 28-64 mm TL.

BIOLOGY: Very little known. Trautman (1957. *The Fishes of Ohio*) indicated that individuals probably live two years. Minckley (1959. Publ. Mus. Nat. Hist. Univ. Kans. 11:401-42) found breeding individuals in mid-August in KS.

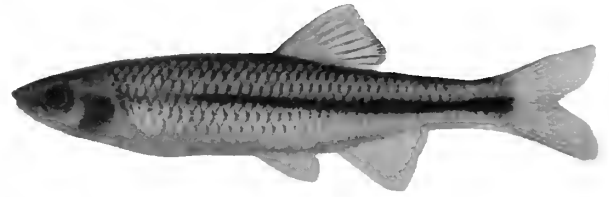
Compiler: C. R. Gilbert. October 1978.

Notropis caeruleus (Jordan)
Blue shiner

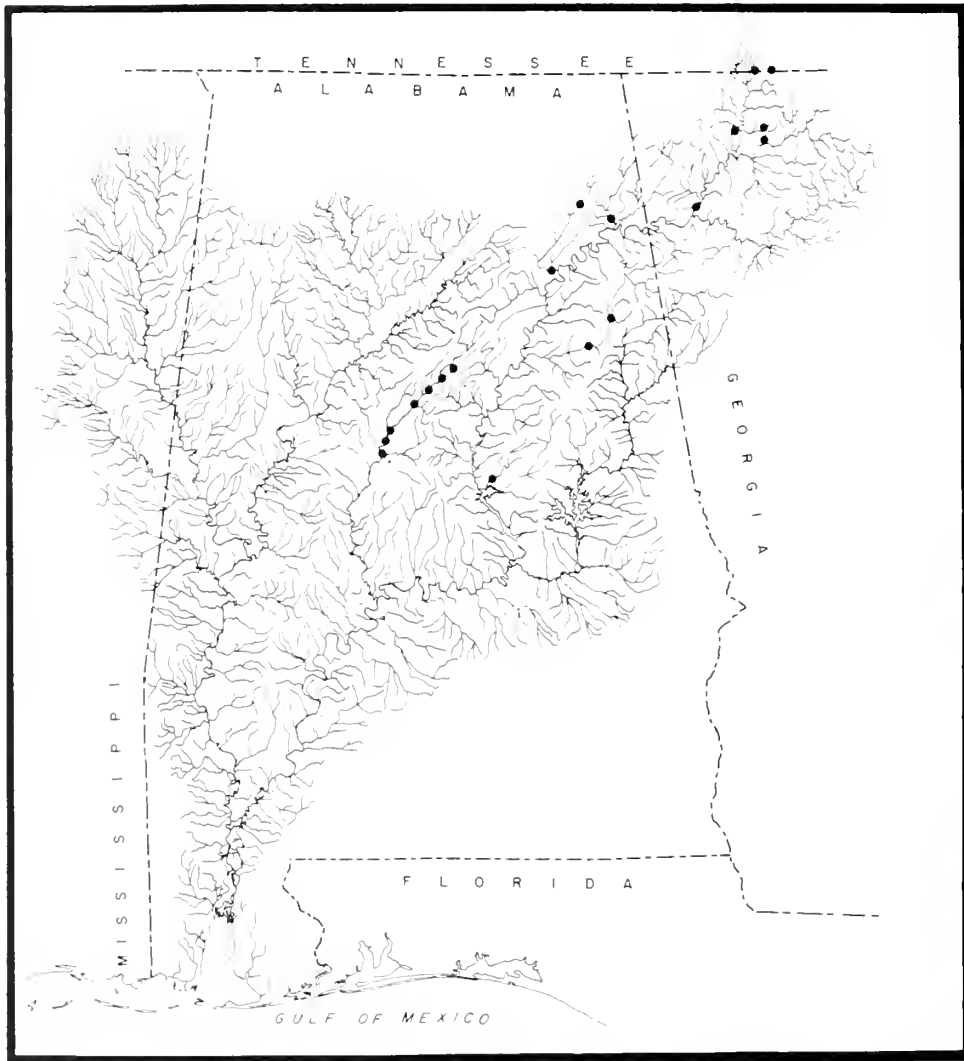
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Oostanaula River (primarily Rocky Creek), above Rome, Floyd Co., GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. 11: 307-77).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1955. Ph.D. diss., Cornell Univ.) reviewed species and subsequently (1957. Copeia: 185-95) discussed relationships. Precise relationships to other members of subgenus unclear.



AL: Bibb Co., Cahaba River system, male, 62 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Endemic to Mobile Bay drainage, where restricted to Cahaba River system, AL, and Coosa River system, AL, GA, and TN. Typically inhabits medium to large clear cool streams having gravel-rubble-small boulder substrate. Seldom common, and now apparently extirpated over much of former range. Good populations still exist in a few tributaries of middle Coosa drainage, AL (Ramsey 1976. Bull. Ala. Mus. Nat. Hist. 2: 53-65), and in Conasauga River system, TN (Stiles and Etnier 1971. J. Tenn. Acad. Sci. 46:12-16).

ADULT SIZE: ca. 50-70 mm SL.

BIOLOGY: Nothing published.

Compilers: C. R. Gilbert, H. T. Boschung, and G. H. Burgess. May 1979.

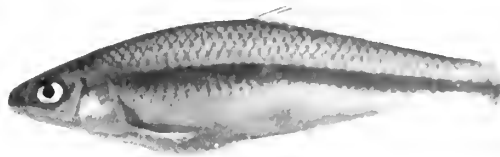
***Notropis callisema* (Jordan)**

Ocmulgee shiner

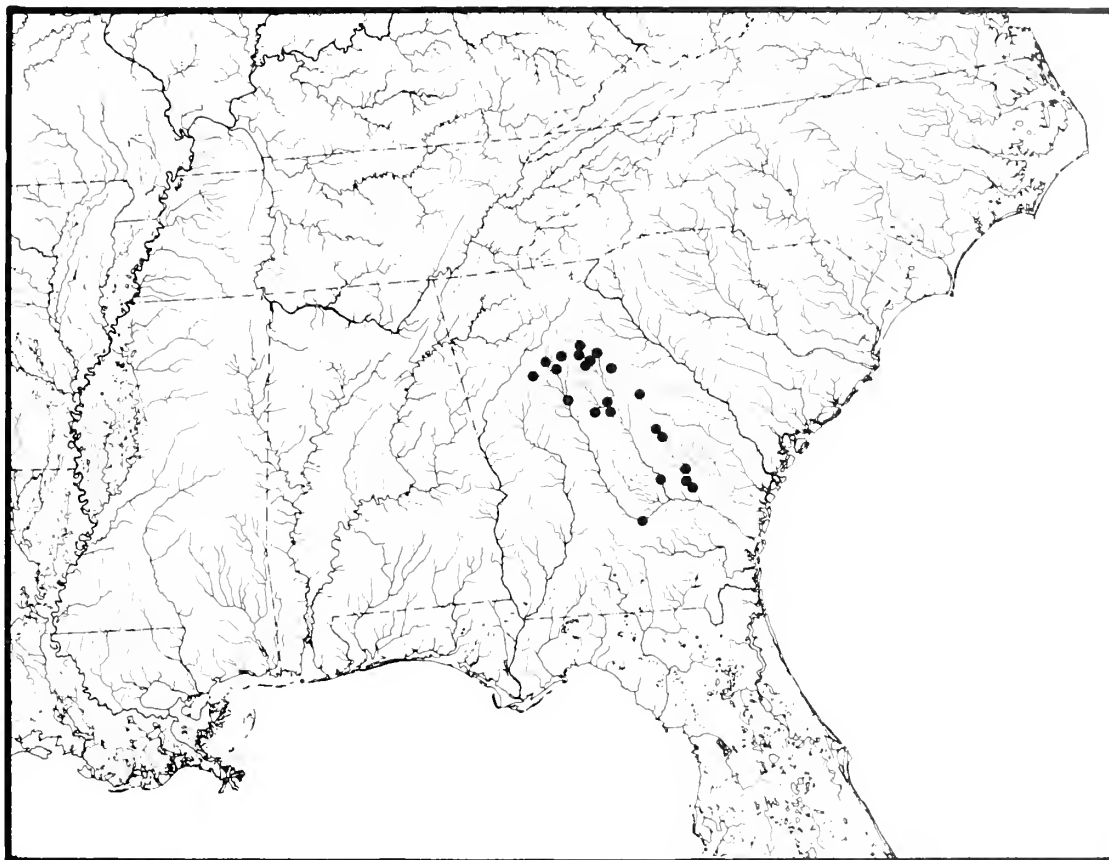
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: South Fork of Ocmulgee River, at Flat Rock, DeKalb Co., GA (Jordan 1877. Ann. N. Y. Lyc. Nat. Hist. 11:307-77).

SYSTEMATICS: Subgenus *Cyprinella*. Forms intimate species complex with *N. callitaenia* and *N. leedsi*, with relationship to former species closer (Gibbs 1955. Ph.D. diss., Cornell Univ.). Next closest relative probably *N. niveus* (Gibbs 1957. Copeia : 185-95).



GA: Hancock-Warren Co.,
Ogeechee River, 70 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Altamaha and Ogeechee river drainages, GA. Usually restricted to larger streams, where occurs in open, sand or rock-bottomed channels with flowing water and little or no vegetation. Sometimes sympatric (and presumably syntopic) with *N. leedsi*, but tends to range farther upstream than that species. Common in preferred habitat.

ADULT SIZE: Not reported, ca. 70 mm SL maximum.

BIOLOGY: Not studied.

Compiler: C. R. Gilbert. December 1978.

Notropis callistius (Jordan)
Alabama shiner

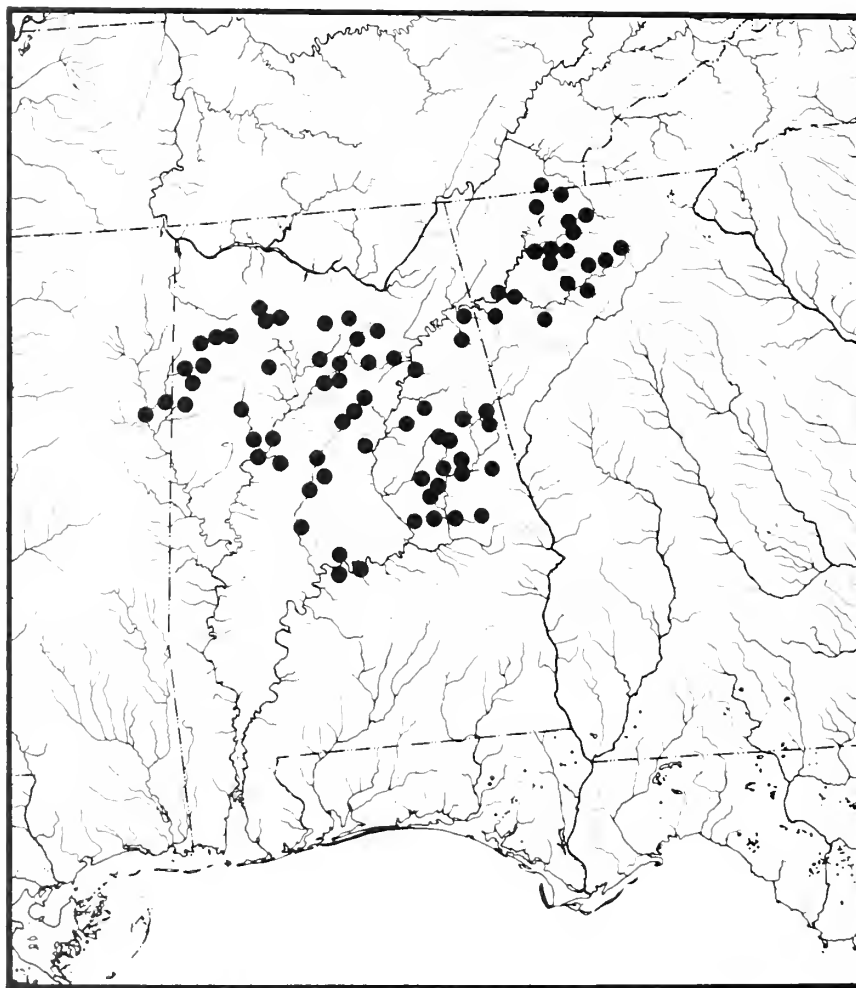
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Etowah and Oostanaula rivers, near Rome, GA. Lectotype probably from Silver Creek, tributary to Etowah River (Jordan 1877. Ann. N.Y. Lyceum Nat Hist. 11:307-77).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1955. Ph.D. diss., Cornell Univ.) reviewed species and subsequently (1957. Copeia: 185-95) discussed relationships. Not intimately related to any other known species, although perhaps closest to species group comprising *N. niveus*, *N. leedsi*, *N. callisema* and *N. calitaenia*.



AL: Tuscaloosa Co., Black Warrior River system (Smith-Vaniz 1968).



Map modified from Gibbs 1955

DISTRIBUTION AND HABITAT: Generally distributed throughout upper half of Mobile Bay basin above Fall Line in AL, GA, and extreme southeastern TN. Widely distributed in Black Warrior drainage of Tombigbee River system, but of limited occurrence in Tombigbee proper. Inhabits flowing, rubble or gravel-bottomed, upland streams of moderate size and varying clarity. Generally common throughout range.

ADULT SIZE: Exact data not available; probably exceeds 75 mm SL.

BIOLOGY: No studies published.

Compiler: C. R. Gilbert. August 1978.

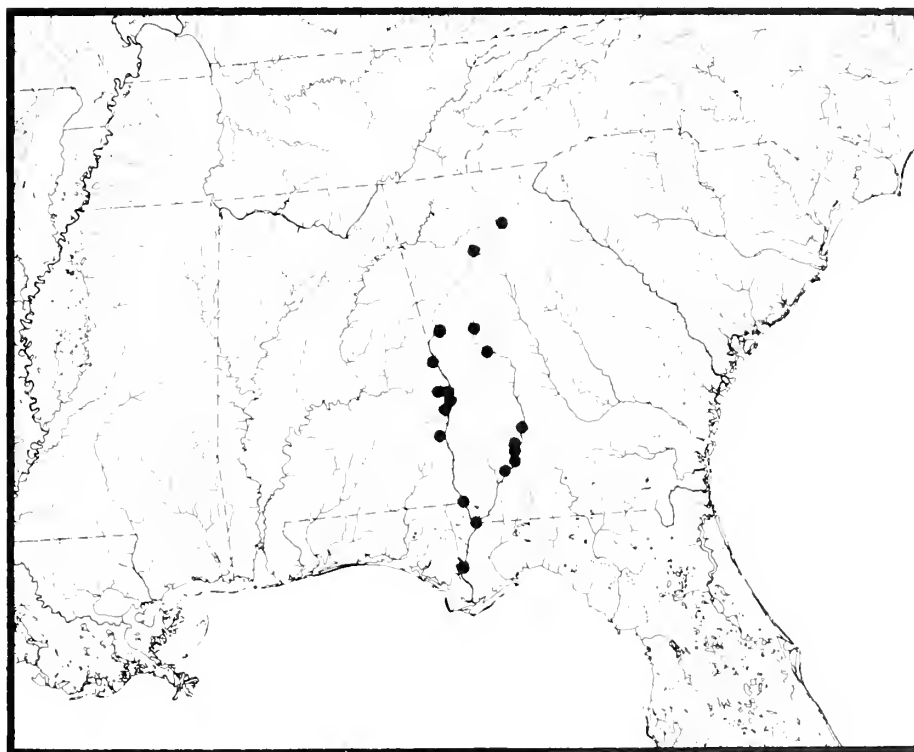
Notropis callitaenia Bailey and
Gibbs
Bluestripe shiner

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Flint River, ca. 1.6 km s of Radium Springs outlet, 8.9 km s of Albany, Dougherty Co., GA (Bailey and Gibbs 1956. Occas. Pap. Mus. Zool. Univ. Mich. 576:1-14).

SYSTEMATICS: Subgenus *Cyprinella*. Forms a closely related species complex with *N. callisema* and *N. lecdsi*, with its relationship to the former species being closer (Gibbs 1955. Ph.D. diss., Cornell Univ.). Next closest relative probably is *N. nireus* (Gibbs 1957. Copeia: 185-95).

AL: Russell Co., Chattahoochee River system, male, 65 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Endemic to Apalachicola River drainage, FL, AL, and GA, where it occurs in the Chattahoochee and Flint rivers and lowermost parts of their major tributaries. Alleged record from Escambia River drainage, in western FL (see Bailey and Gibbs 1956) is now believed to have resulted from transposition of locality data. A large-stream species of open, sand or rocky-bottomed channels with flowing water and little or no aquatic vegetation. May be common in preferred habitat, but much favorable habitat has been eliminated through impoundments, particularly on lower Chattahoochee River.

ADULT SIZE: Largest specimen recorded by Bailey and Gibbs (1956) 71 mm SL.

BIOLOGY: Wallace (1979. ASB Bull. 26: 49) reported on reproductive behavior in AL.

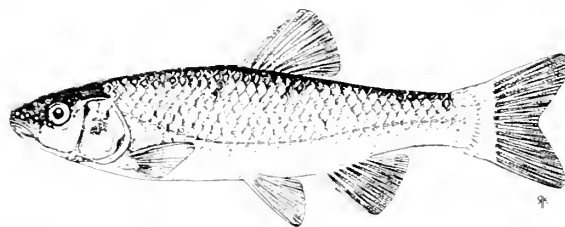
Compiler: C. R. Gilbert. December 1979.

Notropis camurus (Jordan and Meek)
Bluntnose shiner

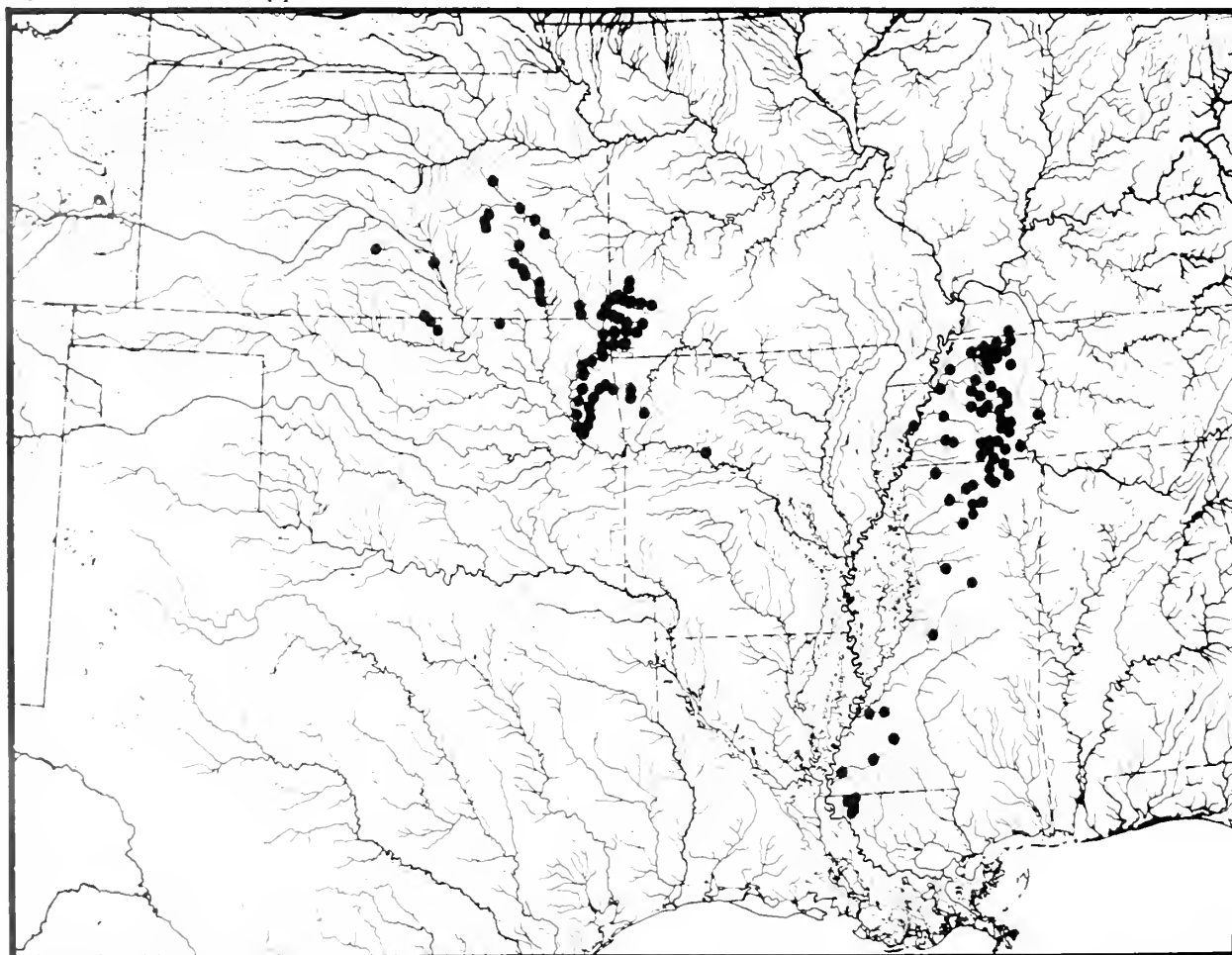
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Fort Lyon, CO (Jordan and Meek 1884. Proc. U.S. Natl. Mus. 7:474-77). Alleged type locality is well west of known range of species (Cross 1967. *Handbook of Fishes of Kansas*). More likely possibility is Lyons Co., in Neosho River system (Arkansas River drainage) of eastern KS (Gilbert 1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1961. Am. Midl. Nat. 66:337-54) reviewed systematics and indicated *N. galacturus* to be closest relative, but may be more closely related to *N. whipplei*.



(NCSM)



DISTRIBUTION AND HABITAT: West flowing streams directly tributary to lower Mississippi River, from LA to KY, and in several tributaries on west side of lower Tennessee River, in TN; west in lower half of Arkansas River drainage of AR, OK, KS, and MO. Habitat ranges from medium-sized streams with sand, gravel, or rubble bottom and moderately fast, clear water, to warmer, more turbid streams.

ADULT SIZE: at least 65 mm SL.

BIOLOGY: Spawns in late spring and early summer in KS (usually early June to mid-July), with tuberculate males taken (during different years) as early as 6 April and as late as 14 August (Cross 1967). Spawns at temperatures of at least 25°C.

Compiler: C. R. Gilbert and G. H. Burgess.
September 1979.

Notropis cerasinus (Cope)
Crescent shiner

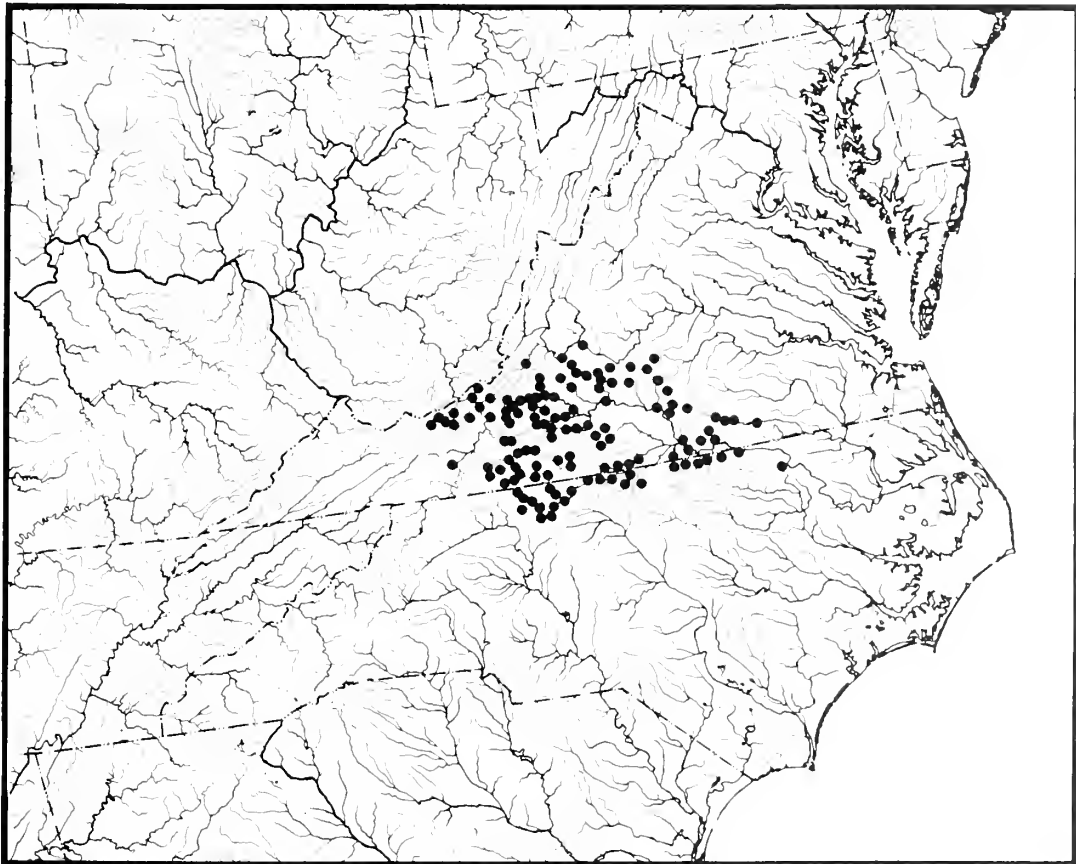
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Headwaters of Roanoke River, Montgomery Co., VA (Cope 1868. Proc. Acad. Nat. Sci. Phila. 19:156-66).

SYSTEMATICS: Subgenus *Luxilus*, Gilbert (1964. Bull. Fla. State Mus. Biol. Sci. 8:95-194) reviewed systematics and concluded, as did Menzel (1976. Biochem. Syst. Ecol. 4: 281-93) who analysed biochemical properties, closest relatives are *N. cornutus*, *N. albeolus*, and *N. chrysocephalus*. However, Buth (in press. Biochem. Syst. and Ecol.), who also studied biochemistry, thinks closer relationships are to *N. coccogenis* and *N. zonistius*.



NC: Rockingham Co., Buffalo Creek, 58 mm SL (NCSM).



Map modified from Gilbert 1964

DISTRIBUTION AND HABITAT: Widespread and common in mountains and Piedmont of Roanoke drainage proper, VA and NC. In upper Chowan system (Roanoke drainage) apparently limited to Meherrin River, VA. Somewhat localized and usually uncommon in New (upper Kanawha) drainage, VA. Perhaps resulting from introductions, occupies a few middle and upper James drainage tributaries, VA, and Cape Fear drainage headwaters, NC. Typically inhabits cool to warm, small to medium-sized streams with highly varied substrates, although generally avoids heavily silted areas.

ADULT SIZE: 88 mm SL.

BIOLOGY: Raney (1947. Zoologica 23:125-32) observed breeding behavior over *Nocomis* nests during late summer. Food consists principally of chironomids and other insect larvae (Schwartz and Dutcher 1962. Am. Midl. Nat. 68:369-75).

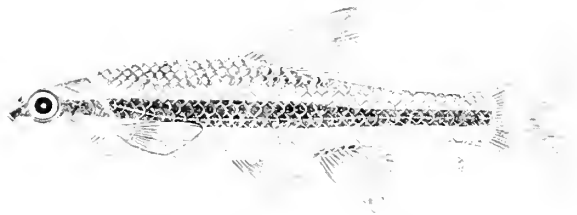
Compiler: C. R. Gilbert. August 1978.

Notropis chalybaeus (Cope)
Ironcolor shiner

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributary of Schuylkill River, near Conshohocken, Montgomery Co., PA (Cope 1869. Trans. Am. Philos. Soc. 13: 351-99).

SYSTEMATICS: Swift (1970. Ph.D. diss., Florida State Univ.) studied systematics. Member of *N. texanus* species group, which also includes *N. petersoni*, *N. asperifrons*, and *N. hypsilepis*. *Notropis chalybaeus abbotti* is a synonym (Swift 1970; Gilbert 1978. Bull. Fla. State Mus. 23: 1-104).



DE: Sussex Co., Thompson Branch (NCSM).



DISTRIBUTION AND HABITAT: Lowlands from Hudson River, NY, south to tributaries of Lake Okeechobee, FL, and west to Sabine River, LA and TX. North to Blake Creek, tributary of Wolf River, WI. Disjunct population in San Marcos River, TX. Low gradient, small, acidic streams with sandy substrate, fishes usually in midwater or near surface. Common along lower Gulf coast, much more sporadic toward peripheries of range.

ADULT SIZE: 45-55 mm TL.

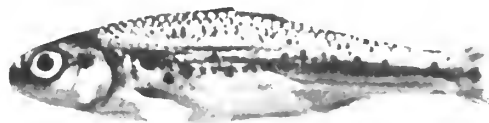
BIOLOGY: Breeds primarily from April to September in FL, with most activity from April to July. Eats small aquatic and terrestrial insects (Marshall 1947. Q. J. Fla. Acad. Sci. [1946] 9:163-88; Swift et al. 1977. Tall Timbers Res. Stn. Misc. Publ. 20:1-111).

Compiler: C. C. Swift. January 1979.

Notropis chihuahua Woolman
Chihuahua shiner

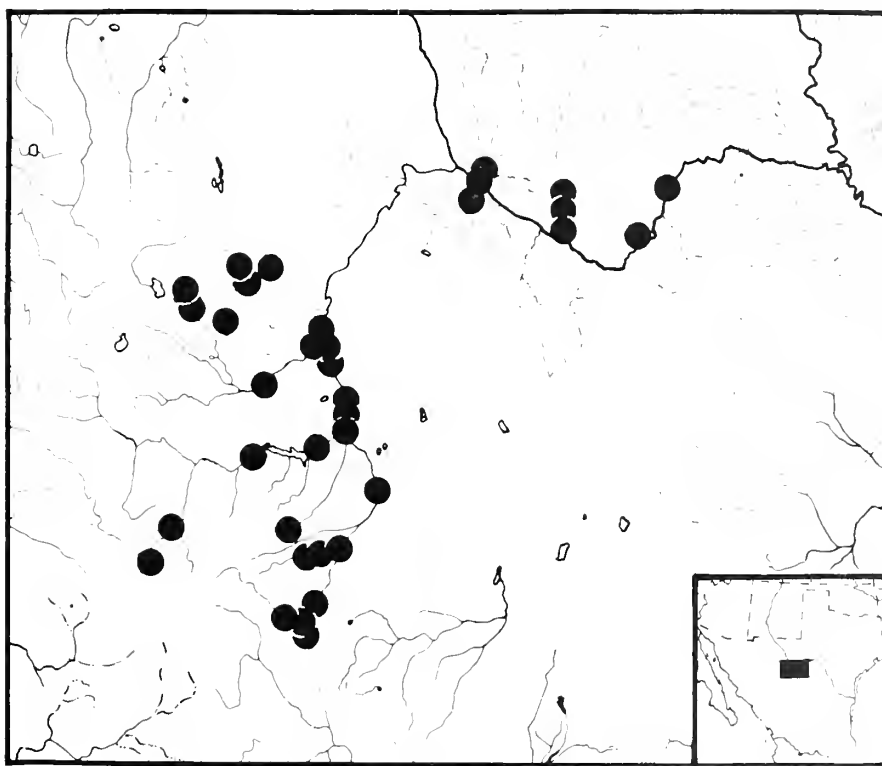
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio de los Conchos at Chihuahua, Chihuahua, Mexico (Woolman 1892. Am. Nat. 26:259-61).



SYSTEMATICS: Of uncertain affinities; possibly close to *N. saladonis*, *N. braytoni*, *N. volucellus* and or *N. buchanani* (Hubbs and Hubbs 1958. Copeia :297-307).

Mexico: Chihuahua, Rio San Pedro at Meoqui, male, 47 mm SL (B. M. Burr).



DISTRIBUTION AND HABITAT: Sporadic in Big Bend region of southwestern TX, but abundant in smaller tributaries of Rio Conchos in Chihuahua and Durango, Mexico. Inhabitant of typically clear, cool water that is often associated with nearby springs. Often in pools with slight current or riffles over a gravel or sand bottom where vegetation may be present.

BIOLOGY: Probable spawning dates listed by Meek (1904. Field Columbian Mus. Publ. 93 [Zool. Ser. 5]: 1-252) as late June and early July. Population fluctuations and presumed spawning in Tornillo Creek, TX, discussed by Hubbs and Wauer (1973. Southwest. Nat. 17:375-79). A poorly known species.

ADULT SIZE: 35-64 mm SL.

Compiler: B. M. Burr. April 1978.

Notropis chiliticus (Cope)
Redlip shiner

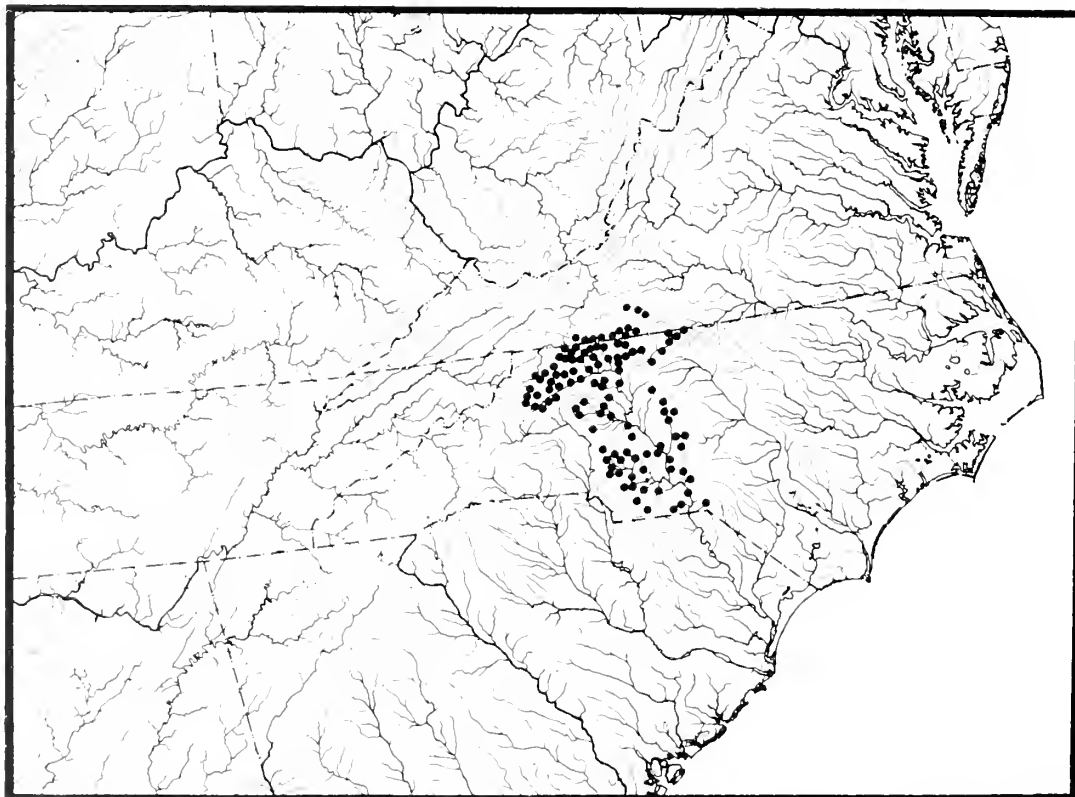
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Yadkin River, Rowan Co., NC (Cope 1870. Proc. Am. Philos. Soc. 11: 448-95).

SYSTEMATICS: Subgenus *Hydrophlox*. Snelson (1968. Copeia: 776-802) noted close similarity in pectoral fin tuberculation pattern to six species of *Notropis*, including *N. rubellus*. Swift (1970. Ph.D. diss., Florida State Univ.) included in *N. rubricroceus* species group of *Hydrophlox*.



NC: Wilkes Co., east prong Roaring River, 41 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Original distribution confined to Pee Dee drainage and Dan River system of Roanoke River drainage, NC and VA. Apparently recently introduced into New River drainage, NC (Menhinick, in press. *The Freshwater Fishes of North Carolina*) and VA. Not included in SC species list (Loyacano 1975. Bull. South Carolina Ag. Exp. Sta. 580:1-8), although Menhinick (in press) shows NC records close to state line. Inhabits clear, small to medium-sized Piedmont and Montane streams having sand-gravel to rubble bottom. Common.

ADULT SIZE: ca. 56 mm SL maximum.

BIOLOGY: Nothing published.

Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Notropis chloristius (Jordan and
Brayton)
Greenfin shiner

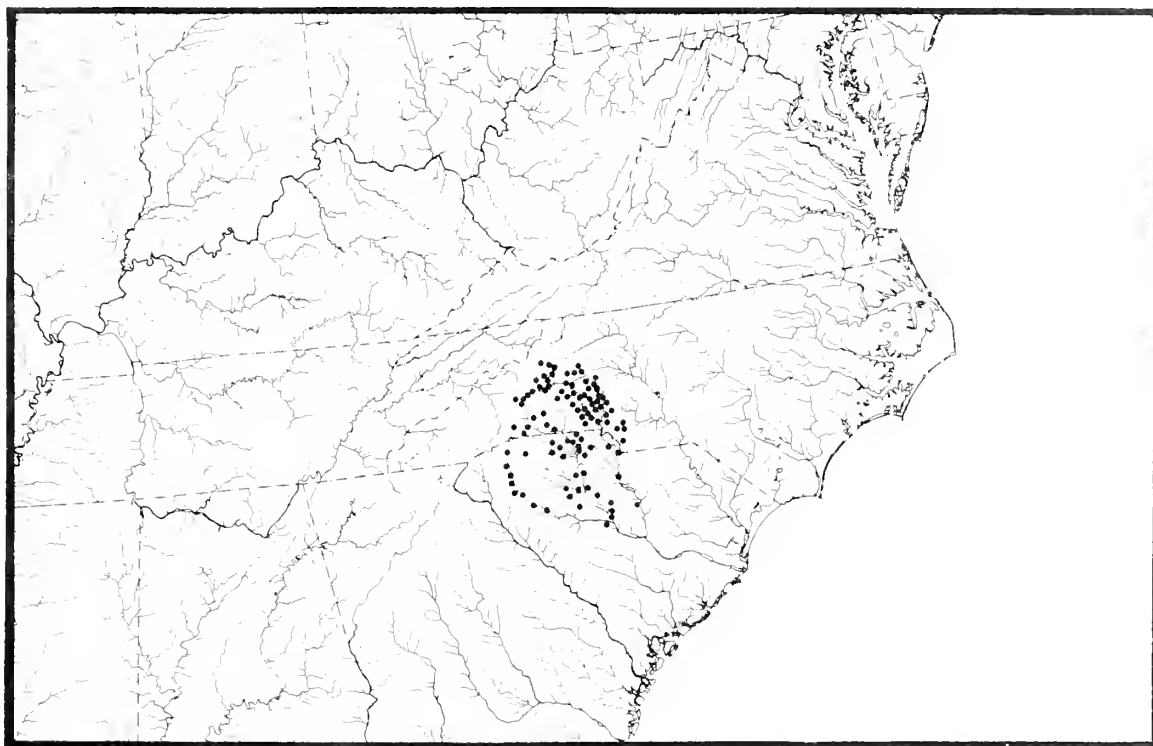
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Saluda River, at Farr's Mills, w of Greenville, Greenville Co., SC (Jordan and Brayton 1878. Bull. U.S. Natl. Mus. 12:1-95).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1963. Copeia:511-28) considered it subspecies of *N. analostanus*, based on limited gene interchange in Pee Dee River drainage, NC (6 of 189 specimens examined were intermediate). Other specimens from this drainage appear to be good *N. analostanus*. Combination of overall morphological distinctness of the two forms and small percentage of intermediates suggests that species recognition is more plausible (as in 1970 and 1980 AFS checklists).



SC: Lancaster-Chesterfield
Co., Lynch River, 66 mm SL
(J.L. Harris).



DISTRIBUTION AND HABITAT: Endemic to Santee River drainage, NC and SC, in montane and upper Piedmont streams above Fall Line. *Notropis analostanus* reaches greatest abundance in somewhat larger waters. Common.

ADULT SIZE: ca. 60 mm SL maximum.

BIOLOGY: Not studied.

Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

Notropis chlorocephalus (Cope)
Greenhead shiner

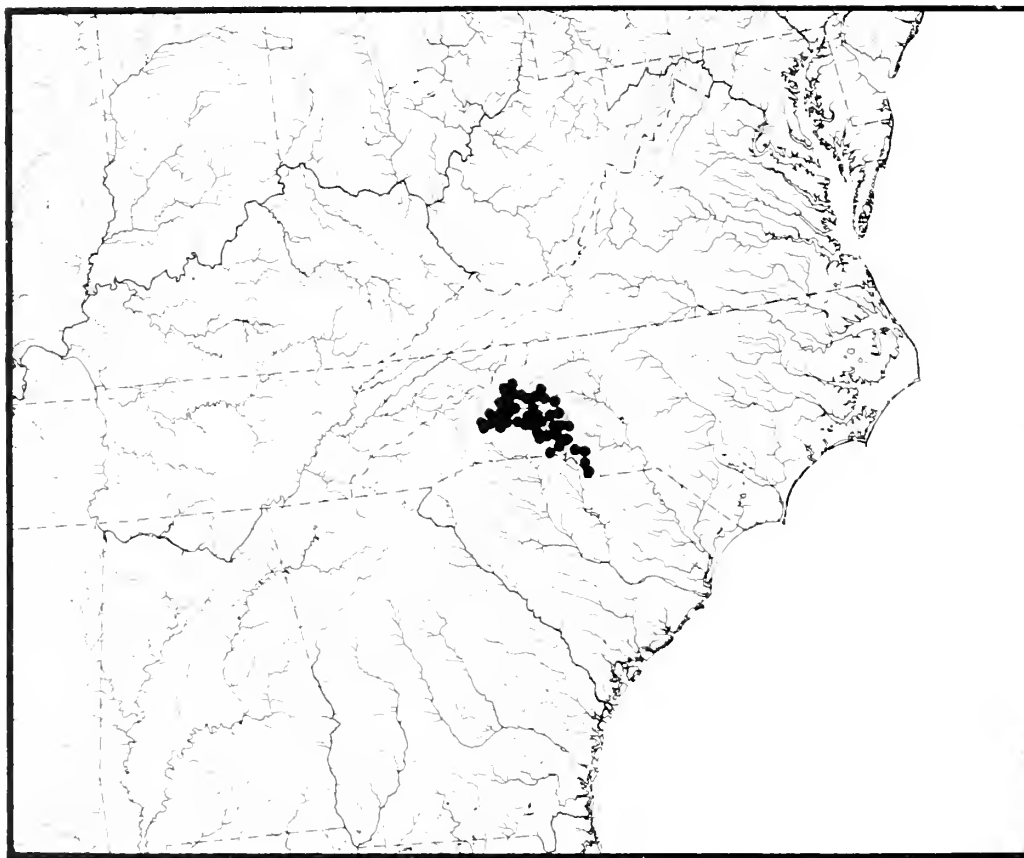
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Catawba River, NC (Cope 1870. Proc. Am. Philos. Soc. 11: 448-95).

SYSTEMATICS: Subgenus *Hydrophlox*. Member of *N. rubricroceus* species group, which includes *N. chiliticus*, *N. baileyi*, and *N. lutipinnis* (Swift 1971. Diss. Abstr. 31B: 3081). Relationship with closest relative, *N. lutipinnis*, being studied by D. J. Moore, Univ. of Florida.



NC: Gaston Co., Hoyles Creek,
55 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to Catawba River system of Santee River drainage, NC and SC. Usually in small, clear headwater streams, where often abundant.

BIOLOGY: No studies published.

ADULT SIZE: ca. 60 mm SL maximum.

Compilers: C. R. Gilbert and G. H. Burgess,
October 1979.

Notropis chrosomus (Jordan)
Rainbow shiner

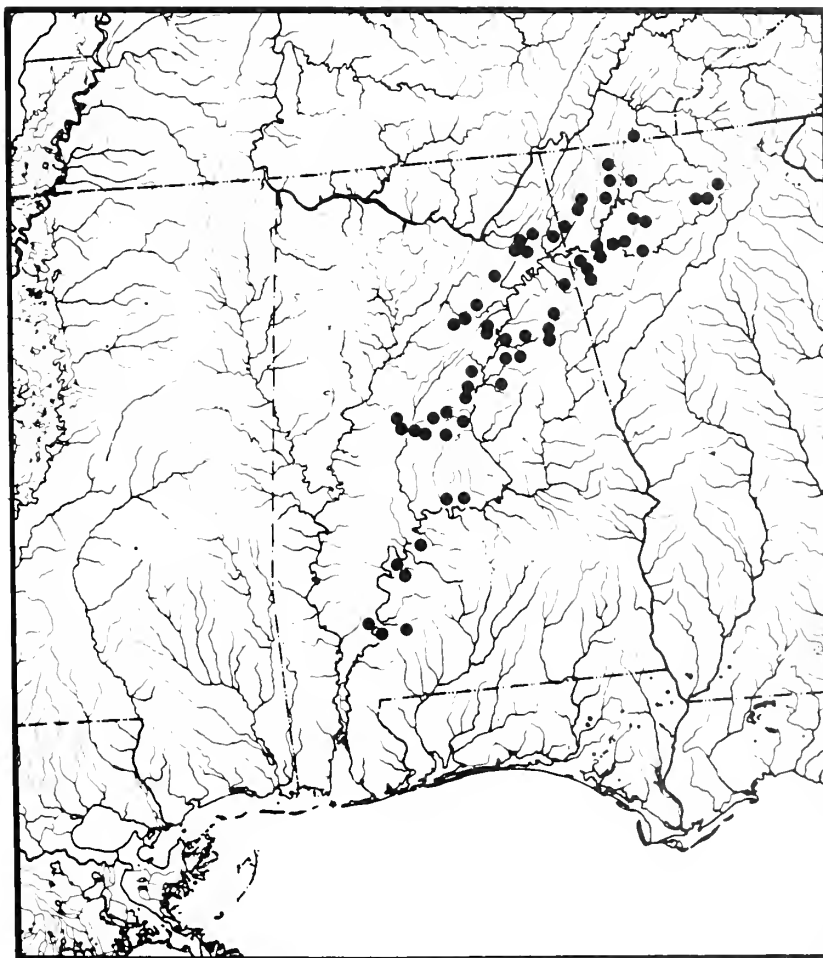
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Etowah River near Rome, GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Subgenus *Hydrophlox* and in species group with *N. leuciodus* and *N. nubilus* (Swift 1970. Ph.D. diss., Florida State Univ.; Gilbert 1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104). Swift (1970) studied systematics.



AL: Etowah Co., Coosa River system, male, 45 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Coosa, Cahaba, Alabama, and Black Warrior river systems (Mobile Bay drainage); possibly introduced in Black Warrior. Small, clear, often spring-fed streams (Swift 1970). Moderately common in preferred habitat.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Little known. Breeds from May to July, based on museum specimens. Hybridizes with *N. baileyi* in White Oak Creek (Dallas Co.) and Pigeon Creek (Clarke Co.), AL (Swift 1970).

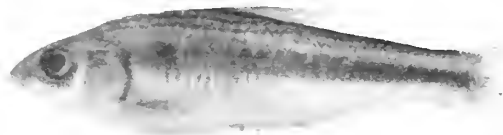
Compiler. C. C. Swift. January 1979.

Notropis chrysocephalus
(Rafinesque)
Striped shiner

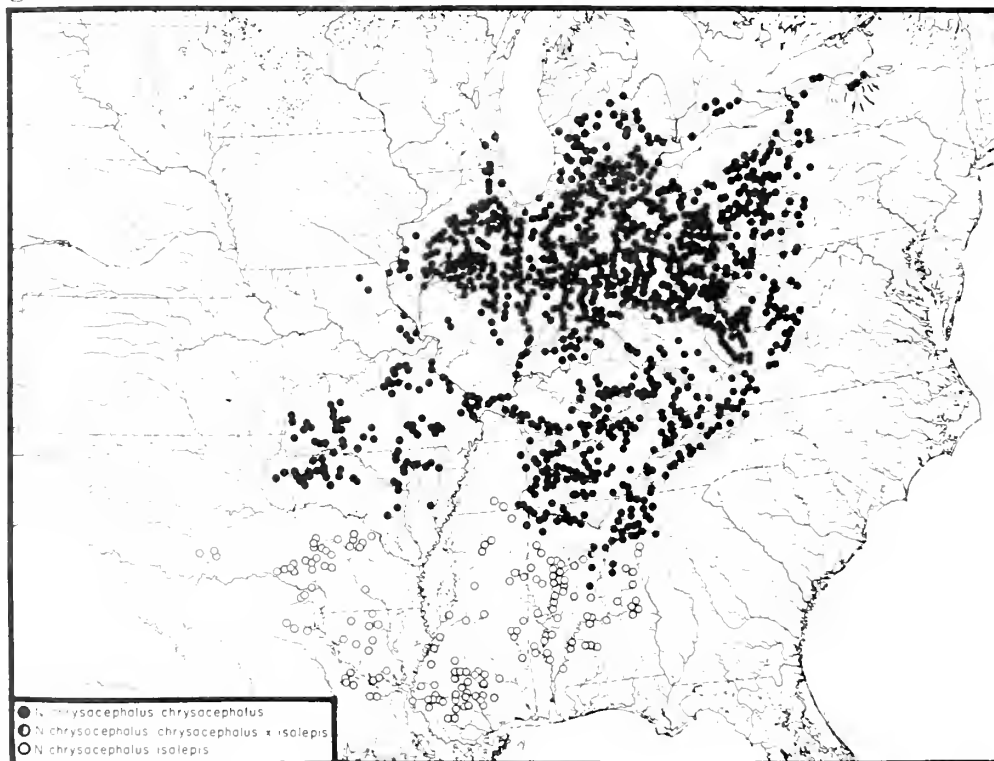
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: "Kentucky" (Rafinesque 1820. *Ichthyologia Ohiensis*). Gilbert (1964. Bull. Fla. State Mus. Biol. Sci. 8:95-194) designated neotype and restricted type locality to a creek ca. 9.7 km ssw of Danville, off state hwy. 35, Lincoln Co., KY.

SYSTEMATICS: Subgenus *Lurilus*. Long regarded as a subspecies of *N. cornutus*, until elevated to species level by Gilbert (1961. Copeia:181-92), who considered distinctive form *isolepis* as a subspecies of *N. chrysocephalus*. Based on the protein patterns, Menzel (1976. Biochem. Syst. Ecol. 4:281-93) considered *N. cornutus* and *N. chrysocephalus* as subspecies and *isolepis* full species, but Buth (in press. Biochem. Syst. Ecol.), on the basis of subsequent studies utilizing the same characters as Menzel, favored retention of Gilbert's systematic arrangement.



AR: Polk Co., tributary to
Ouachita River, 63 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Southern half of Great Lakes basin from western NY and southeastern WI, south to Gulf coast (Mississippi River basin to Mobile Bay drainage). Typical subspecies occurs south to Arkansas and Tennessee river drainages, and intergrades with subspecies *isolepis* in lower Coosa River system, AL, and lower Tennessee River drainage, AL and TN. Hybridizes in irregular fashion with *N. cornutus* throughout Great Lakes basin and in much of upper Ohio River drainage. Typically in medium-sized streams having clear weedless waters, a moderate to swift current, and alternating pools and riffles over a gravel

or rubble bottom, often with some silt. Usually abundant.

ADULT SIZE: ca. 65-100 mm SL.

BIOLOGY: Very similar to *N. cornutus*, and the observations of Adams and Hankinson (1928. Roosevelt Wild Life Ann. 1:235-548) and Raney (1940. Zoologica 25:1-14) on food habits, general ecology, and spawning of that species are also applicable to *N. chrysocephalus*. Gilbert (1964) and Scott and Crossman (1973. *Freshwater Fishes of Canada*) provided overall summaries.

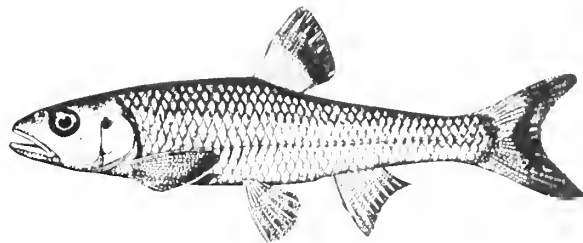
Compiler: C. R. Gilbert. April 1979.

Notropis coccogenis (Cope)
Warpaint shiner

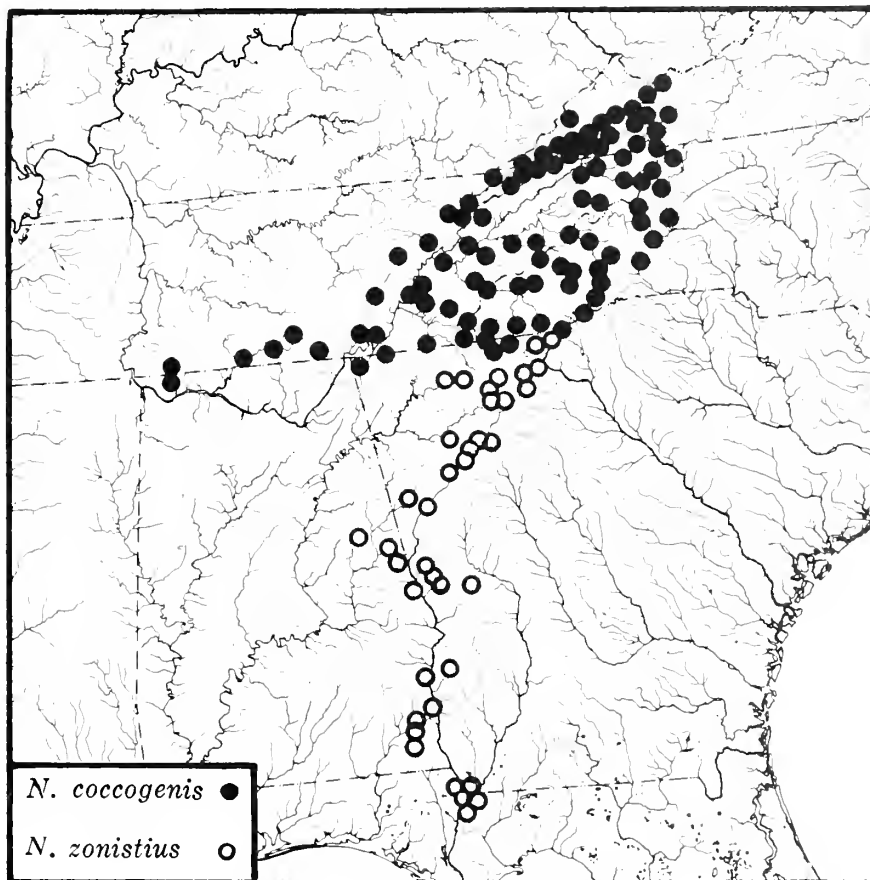
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Holston River, VA (Cope in Günther 1868. *Catalogue of the Fishes in the British Museum* 7:1-512).

SYSTEMATICS: Subgenus *Luxilus*. Gilbert (1964. Bull. Fla. State Mus. Biol. Sci. 8:95-194) studied systematics and showed closest relative to be *N. zonistius*. Menzel (1976. Biochem. Syst. Ecol. 4:281-93) and Buth (in press. Biochem. Syst. Ecol.) studied biochemical relationships.



TN: Arnwine Spring Creek, Mount Verd, ca. 85 mm SL (Jordan and Evermann 1900).



Map modified from Gilbert 1964

DISTRIBUTION AND HABITAT: Upper half of Tennessee River drainage from northwestern AL and northwestern GA north to western VA. Isolated population in Cypress Creek watershed, northwestern AL. Also in headwaters of Savannah River drainage of NC and SC (native), upper Santee River drainage of NC (probably native), and upper New River drainage of NC (presumably introduced). Inhabits riffles and flowing pools of medium to large, usually clear, upland streams. Characteristically occurs in middle to upper levels of water column over bottom composed of rubble and gravel. Common.

ADULT SIZE: 76-102 mm TL, ca. 116 mm SL maximum.

BIOLOGY: Outten (1957. J. Elisha Mitchell Sci. Soc. 73:68-84) published detailed account of biology. Spawns early June to mid-July in western NC at a water temperature of 20° C or higher in riffles or rapids, often over nests of *Nocomis micropogon*. Spawning behavior similar to that observed for *N. cornutus*. Most individuals mature in two years, and small number may live as long as four years. Feeds largely on terrestrial and aquatic invertebrates, principally insects, which are usually taken at surface of water.

Compiler: C. R. Gilbert. August 1978.

***Notropis cornutus* (Mitchill)**
Common shiner

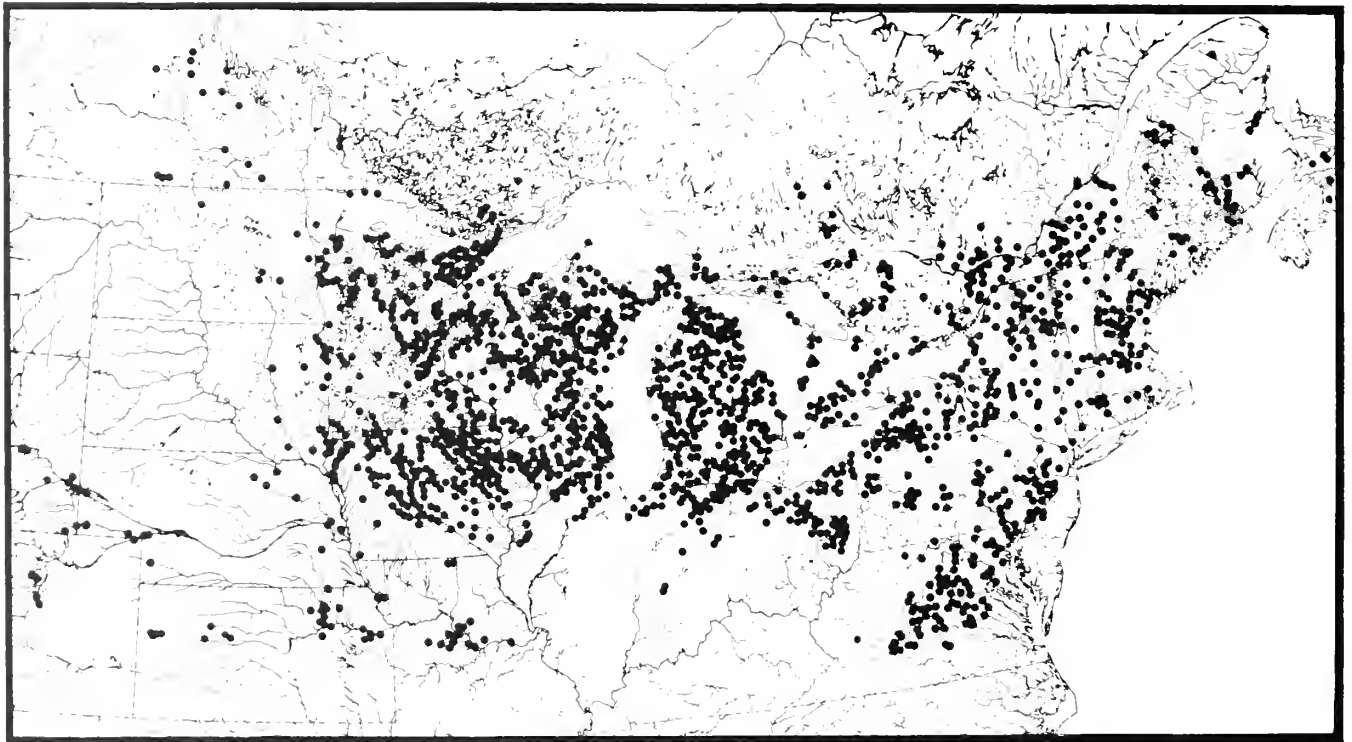
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Wallkill River, 4.8 km sw of New Paltz, Ulster Co., NY (Mitchill 1817. Am. Mon. Mag. Crit. Rev. 1:289-90).

SYSTEMATICS: Subgenus *Luxilus*. Gilbert (1964. Bull. Fla. State Mus. Biol. Sci. 8:95-194) reviewed systematics of species. Hybridizes extensively with *N. chrysocephalus* (Gilbert 1961. Copeia:181-92). Based on blood protein patterns Menzel (1976. Biochem. Syst. Ecol. 4:281-93) considered *N. cornutus* and *N. chrysocephalus* as subspecies. *N. olbeolus* is also closely related to *N. cornutus* and replaces it on middle Atlantic coast.



MD: Harford Co., Swan Creek, male, 88 mm SL (NCSM).



Map modified from Gilbert 1964

DISTRIBUTION AND HABITAT: Upper half of Atlantic slope, most of Great Lakes drainage, lower Missouri and upper Mississippi river basins, and southern extreme of Hudson Bay drainage (Red River of North system only). Common in small to medium-sized streams with clear, cool, weedless water, moderate to swift current, gravel to rubble bottom, and alternating pools and riffles, but usually avoids riffles themselves. In Great Plains area may occur in warmer and more turbid waters.

ADULT SIZE: 64-102 mm SL.

BIOLOGY: Adams and Hankinson (1928. Roosevelt Wild Life Ann. 1:355-58) analyzed food habits and general ecology. Raney (1940. Zoologica 25:1-14) analyzed breeding habits. Overall summary by Gilbert (1964) and Scott and Crossman (1973. *Freshwater Fishes of Canada*).

Compiler: C. R. Gilbert. February 1978.

Notropis cummingsae Myers
Dusky shiner

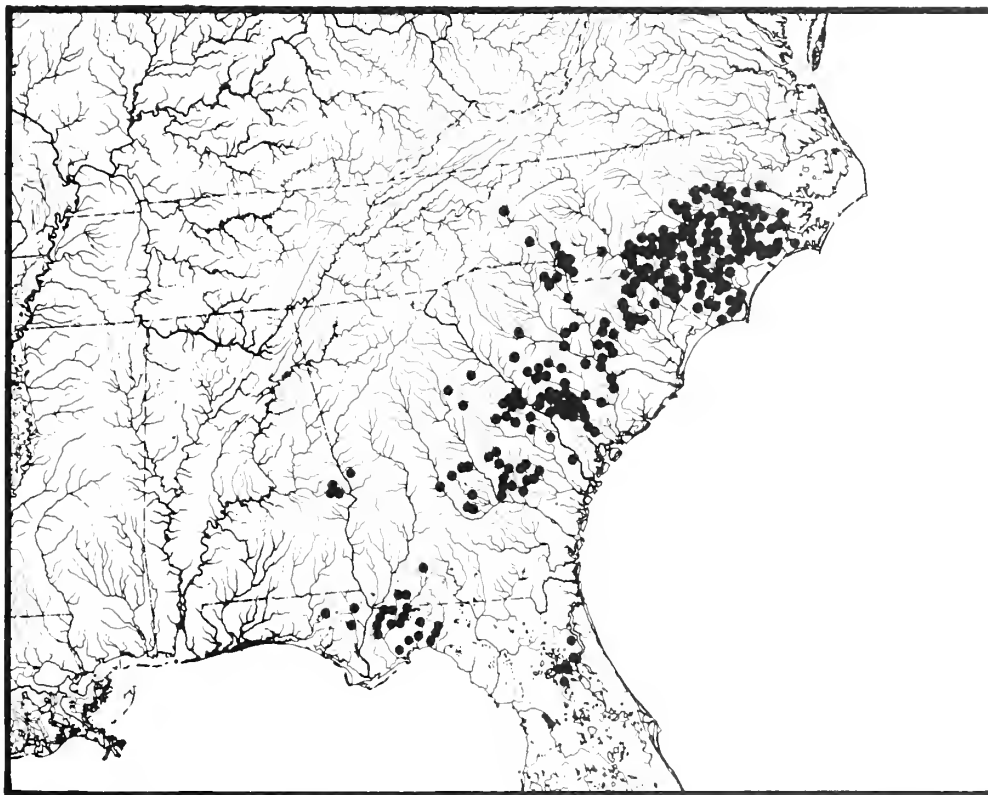
Order Cypriniformes
Family Cyprinidae



SC: Barnwell Co., Savannah
River system, 44 mm SL
(Smith-Vaniz 1968).

TYPE LOCALITY: Upper Burnt Mill Creek, Wilmington, New Hanover Co., NC (Myers 1925. Am. Mus. Novit. 168:1-4).

SYSTEMATICS: Hubbs and Raney (1951. Occas. Pap. Mus. Zool. Univ. Mich. 535: 1-25) reviewed species and recognized two subspecies (*N. c. cummingsae* and *N. c. collis*), which differ only in anal ray count. Martin (1949. Univ. Toronto Stud., Biol. Ser. 58, Publ. Ont. Fish. Res. Lab. 70:1-91) showed that such differences often result of environmental temperatures during embryonic development, thus tendency is to not recognize subspecies. Precise relationships of species not determined, but closely resembles and frequently confused with *N. altipinnis*, a sympatric species throughout much of range.



DISTRIBUTION AND HABITAT: Unique, partly disjunct distribution, from lower Tar River drainage, NC, south to lower St. Johns River drainage, FL, west to Choctawhatchee River drainage, FL. Generally distributed south to Altamaha River drainage, GA, mostly in Coastal Plain habitats, but to south and west occurs in three distinct isolated areas: middle Chattahoochee River system, GA and AL; from Choctawhatchee drainage east to Aucilla drainage, FL and GA; and lower St. Johns drainage, FL. Burgess et al. (1977. Fla. Scientist 40:33-41) mapped FL

distribution and presented possible reasons for disjunct distribution. Burgess and Franz (1978. Am. Midl. Nat. 100:160-70) discussed geological and historical evidence explaining isolated St. Johns population. Usually common.

ADULT SIZE: 30-60 mm SL.

BIOLOGY: Not studied.

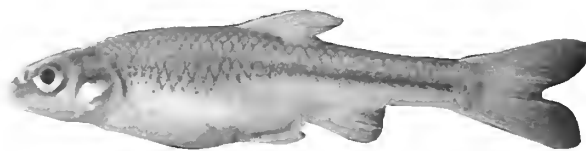
Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

Notropis dorsalis (Agassiz)
Bigmouth shiner

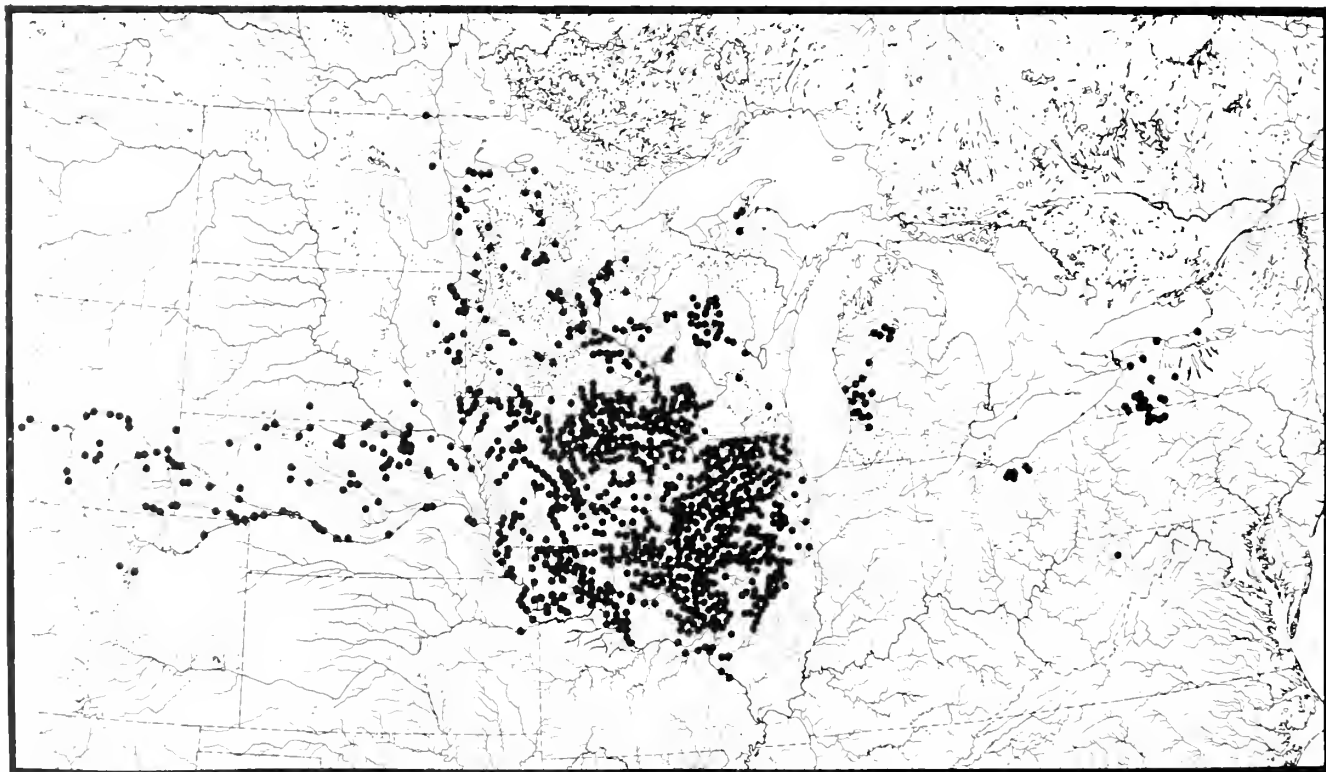
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Burlington, IA (Agassiz 1854. Am. J. Sci. Arts 17:297-308, 353-65).

SYSTEMATICS: No definitive systematic study throughout entire range, although Underhill and Merrell (1959. Am. Midl. Nat. 61: 133-47) studied intraspecific variation in MN. Precise relationships to other *Notropis* species not determined, but most closely resembles such species as *N. stramineus* and *N. volucellus*. Two subspecies sometimes recognized, based primarily on presence (*N. d. dorsalis*) or absence (*N. d. piptolepis*) of predorsal scales.



MO: Boone Co.—Moniteau Co.,
Missouri River tributary,
44 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Southern MB, eastern WY and northeastern CO east to western NY, north-central PA, and northern WV. Distribution continuous east to IL and WS, but oddly discontinuous from there east, with isolated populations in both upper and lower peninsulas of MI, northern OH, western PA and NY, and northern WV. Trautman (1957. *The Fishes of Ohio*) indicated present disjunct distribution over eastern half of range results from past expansion, and subsequent retreat, of dry prairie conditions. Inhabits shallow, open, prairie-like streams with bottom predominantly sand, often overlain with silt. Usually abundant in western half of range, much less so to east.

ADULT SIZE: 69 mm TL maximum.

BIOLOGY: Starrett (1950a. Ecology 31:216-33; 1950b. Am. Midl. Nat. 43: 112-27), Paloumpis (1958. Iowa St. J. Sci. 32: 547-62), Griswold (1963. Proc. Iowa Acad. Sci. 70: 215-23) and Keeton (1963. Ph.D. diss., Iowa State Univ.) reported various aspects of biology. Feeds mainly on insects, but also includes some bottom ooze and plant material (Starrett 1950a). Spawns May to July in IL (Smith 1979. *The Fishes of Illinois*). Often lives three years (Keeton 1963), occasionally four (Griswold 1963). Probably spawns in mid-water, with eggs drifting downstream (Moore 1944. Copeia: 209-14). Habitat very similar to that of *Ericymba buccata*, but apparent ecological competition results in little syntopy despite broadly overlapping ranges (Trautman 1957). Compilers: C. R. Gilbert and G. H. Burgess. September 1979.

***Notropis edwardraneyi* Suttkus
and Clemmer
Fluvial shiner**

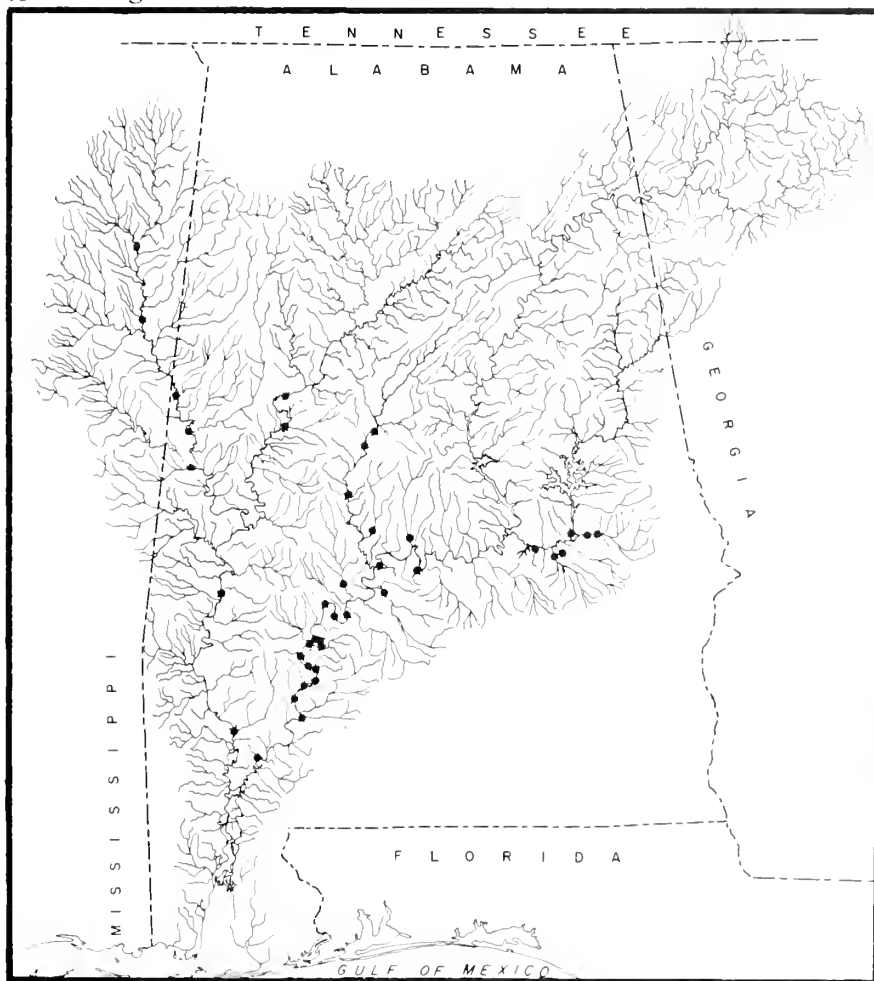
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Alabama River, at Yellow Jacket Bar, river km 208.8, 1.9 km down-river from Holly Ferry crossing or 20.1 km e of Pine Hill, Wilcox Co., AL (Suttkus and Clemmer 1968. Tulane Stud. Zool. Bot. 15: 18-39).

SYSTEMATICS: Subgenus *Alburnops*. Suttkus and Clemmer (1968) reviewed systematic relationships. Apparently most closely related to *N. blennius*, less so to *N. potteri*. Suttkus and Clemmer (1968) hypothesized that morphological similarities with *N. potteri* may be due to convergence.



MS: Lowndes Co., Tombigbee River, 43 mm SL (J.L. Harris).



Map from Suttkus and Clemmer 1968

DISTRIBUTION AND HABITAT: Endemic to Mobile Bay drainage, where occurs mostly in main channels of Tombigbee, Black Warrior, Cahaba, and Alabama rivers generally below Fall Line. Apparently absent from Coosa River. Usually in areas of good current with water of varying turbidity and substrate consisting of a mixture of sand, gravel, and silt. Abundant in past, but declined in recent years.

ADULT SIZE: 65 mm SL maximum.

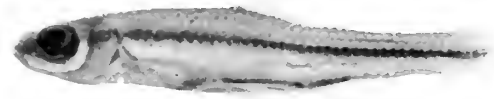
BIOLOGY: Ripe or spawning individuals collected in moderate current along bank over sand bottom in late June. Water depth varied from 0.3-0.7 m and water temperature was 28° C. Additional breeding dates listed in Suttkus and Clemmer (1968). No information on behavior, feeding, or age.

Compiler: C. R. Gilbert. August 1978.

Notropis emiliae (Hay)
Pugnose minnow

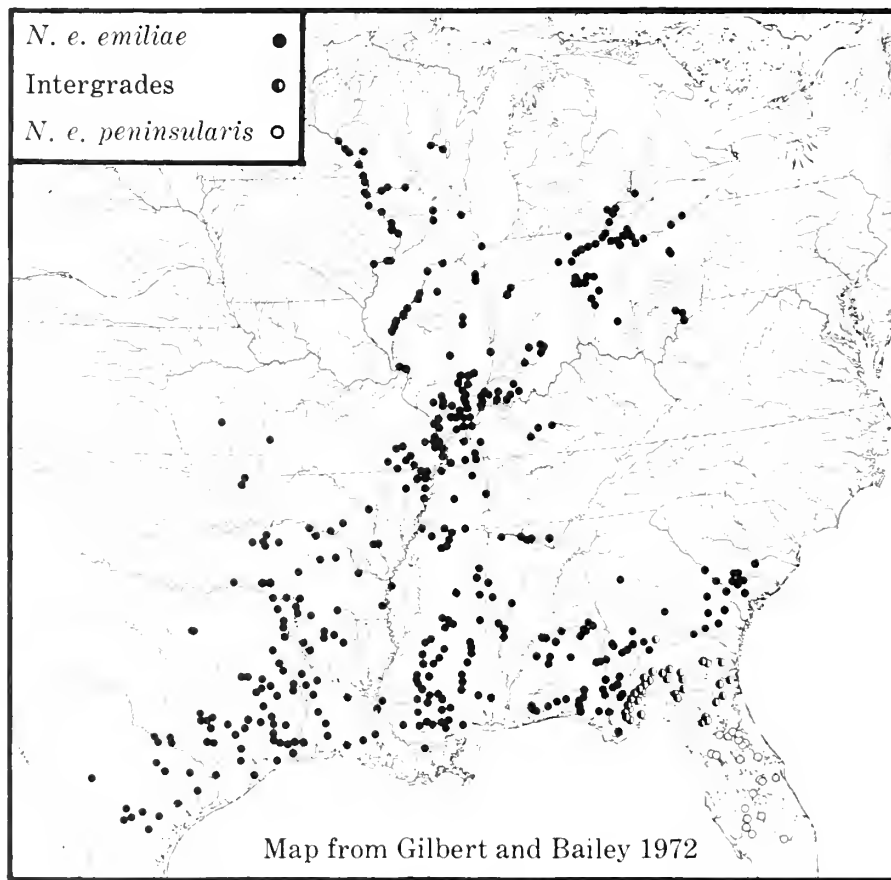
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Horsehunter Creek, near confluence Noxubee River, Macon, Noxubee Co., MS (Hay 1881. Proc. U.S. Natl. Mus. 3:507-08).



SYSTEMATICS: Gilbert and Bailey (1972. Occas. Pap. Mus. Zool. Univ. Mich. 664:1-35) recognized the subspecies *N. e. peninsularis*, endemic to peninsular FL, which intergrades with *N. e. emiliae* in northern FL and southern GA. Although Gilbert and Bailey (1972) transferred the species from the monotypic genus *Opsopoeodus* to *Notropis*, this action was disputed by Campos and Hubbs (1973. Copeia:161-63) on the basis of chromosome counts.

AL: Dale Co., tributary of
Choctawhatchee River, 41 mm
SL (NCSM).



DISTRIBUTION AND HABITAT: Nueces River drainage southern TX east to Edisto drainage SC. North in Mississippi Valley to TN, southeastern MN, Lake Winnebago drainage WI, east to Lake Erie drainage in extreme southern MI and western ON, and to western WV (Ohio River System). Peninsular FL subspecies occurs from St. Johns drainage south to Lake Okeechobee. Usually in clear, sluggish, often weedy waters, where it may be common.

BIOLOGY: No comprehensive ecological study exists. Gilbert and Bailey (1972) summarized available information. Food of FL specimens consisted of chironomid larvae, copepods, and other invertebrates. Breeds in mid-June in IL, but the species appears to have a much more extended breeding season in FL (March to September).

ADULT SIZE: 50 mm SL maximum.

Compiler: C. R. Gilbert. February 1978.

***Notropis euryzonus* Suttkus**
Broadstripe shiner

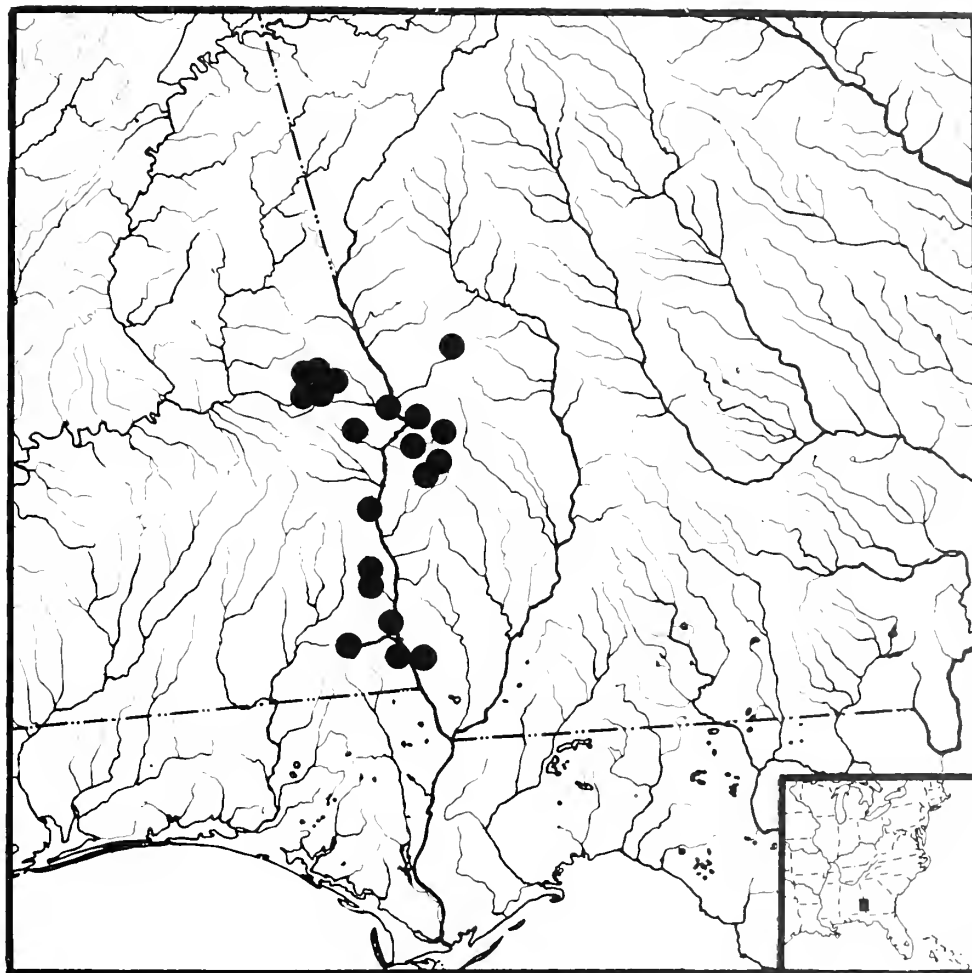
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Uchee Creek, tributary to Chattahoochee River, 1.1 km e of Marvyn, Lee Co., AL (Suttkus 1955. Tulane Stud. Zool. 3:85-100).

SYSTEMATICS: Subgenus *Pteronotropis*. Very closely related to *N. hypselopterus*, more distantly to *N. signipinnis*.



AL: Lee Co., Chattahoochee River system. 44 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Endemic to middle Chattahoochee system GA and AL (Apalachicola River drainage). Occurs in small, clear streams in which water is often brownish. Usually taken near logs or aquatic vegetation over various substrates (mud and clay, shifting sand and silt, and exposed bed-rock). Although range overlaps with closely related *N. hypselopterus* in lower Chattahoochee system, they have never been found syntopically (Gilbert 1969. M. Sc. thesis, Auburn Univ.). May be locally abundant in preferred habitat.

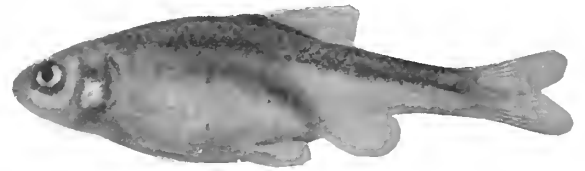
ADULT SIZE: 39-49 mm SL.

BIOLOGY: No life history studies have been published. Unpublished studies have been conducted by F. William Vockell, formerly of Florida State University.

Compilers: C. R. Gilbert and S. P. Platania.
May 1978.

Notropis formosus (Girard)
Beautiful shiner

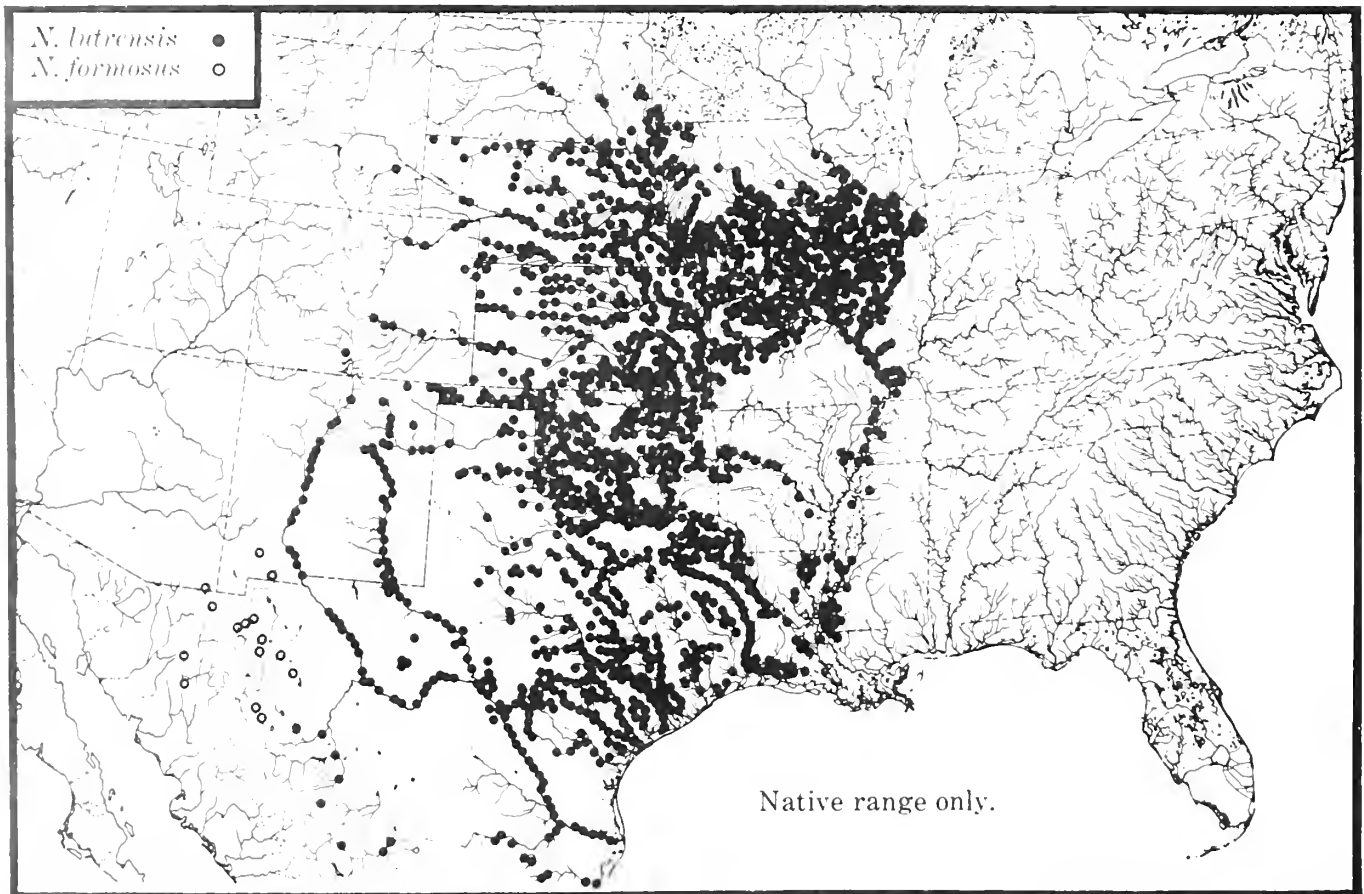
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: Probably Mimbres River, near Deming, Luna Co., NM (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213). Type locality not Rio Mimbres, Mexico (see Gilbert 1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104).

SYSTEMATICS: Subgenus *Cyprinella*. Highly variable; four races in Mexico and southwest United States (Contreras-B. 1975. Ph.D. diss., Tulane University), including *N. mearnsi*, which may be a distinct subspecies (Minckley 1973. *Fishes of Arizona*). Specific status of *N. formosus* has been questioned by Contreras-B. (1975), who regarded it as a subspecies of *N. lutrensis* (see also Gilbert 1978).

Mexico: Chihuahua, Rio Papi-gochic, 49 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Northern Mexico, in rios Yaqui, Cases Grandes, and Santa Maria and Carmen drainages; in United States reported from southern AZ and NM.

BIOLOGY: Little reported in literature. Like many southwestern cyprinids, this species occupies streams that are subject to desiccation and environmental extremes. Miller and Simon (1943. Copeia:253) reported the *N. mearnsi* form from a small, muddy pool over a bottom of gravel, sand, and boulders.

ADULT SIZE: to ca. 70 mm SL.

Compiler: W. J. Matthews. August 1979.

***Notropis fumeus* Evermann**
Ribbon shiner

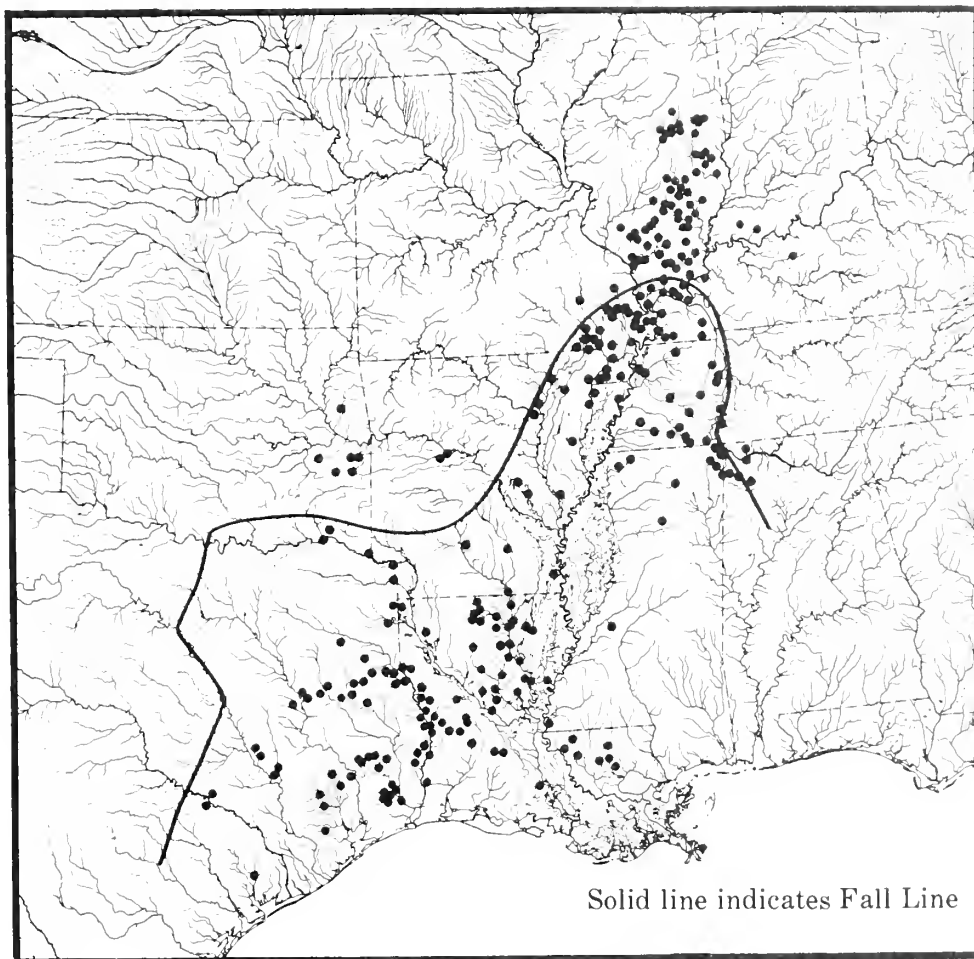
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Hunter Creek, about 14 km w of Houston, San Jacinto drainage, Harris Co., TX (Evermann 1892. Bull. U. S. Fish Comm. [1891] 11:61-90).

SYSTEMATICS: Subgenus *Lythrurus*. Minor geographic variation, primarily in tuberculation. No subspecies. Often confused with *N. umbratilis*. Previously confounded with undescribed Ouachita Mountain shiner. Snelson (1973. Am. Midl. Nat. 89:166-91) reviewed systematics.



TN: Hardeman Co., Piney Creek, male, 47 mm SL (F. F. Snelson).



Map from Snelson 1973

DISTRIBUTION AND HABITAT: Widespread in lowland streams of Mississippi embayment from LA to IL. Usually below Fall Line but extends considerably above in Arkansas River drainage and in IL, IN, and KY. In Gulf slope drainages from Lake Pontchartrain west through Navidad River in TX. In small to medium-sized lowland streams, usually with low gradient and bottom materials of sand and silt or clay. Tolerant of turbidity and associated ecological

factors characteristic of creeks and ditches flowing through agricultural areas. Locally common, perhaps increasing in abundance and distribution in agricultural regions (Snelson 1973).

ADULT SIZE: 35-55 mm SL.

BIOLOGY: Nothing known.

Compiler: F. F. Snelson, Jr. September 1978.

Notropis galacturus (Cope)
Whitetail shiner

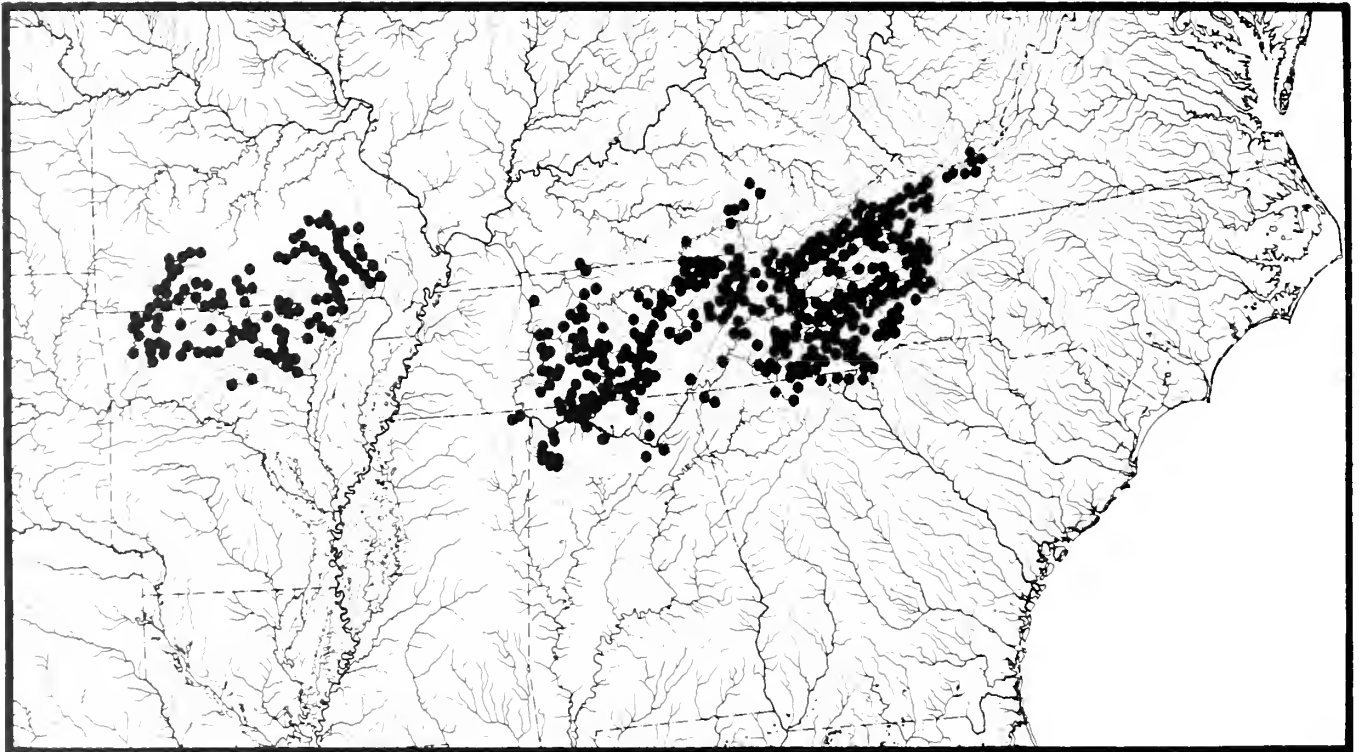
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Holston River system, VA (Cope 1868. Proc. Acad. Nat. Sci. Phila. [1867] 19:156-66).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1961. Am. Midl. Nat. 66:337-54) reviewed species and indicated its closest relative was *N. camurus*, but evidence suggests the latter may be more closely related to *N. whipplei* and *N. analostanus*.



NC: Madison Co., French Broad River, 71 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Disjunct distribution on both sides of Mississippi River. To the west, in Ozark Plateau and Ouachita Mountain portion of White and St. Francis river systems, AR and MO; to the east, in Tennessee and Cumberland river drainages of AL, GA, NC, TN, VA, and KY. Also in upper Savannah and Santee river drainages, on Atlantic slope, and believed to have reached there via natural stream capture. Population in New (upper Kanawha) river system, VA, believed to be human introduction, since not present in early collections. In cool, usually clear streams of moderate to occasionally small size, with bottom of gravel and rubble. Usually common.

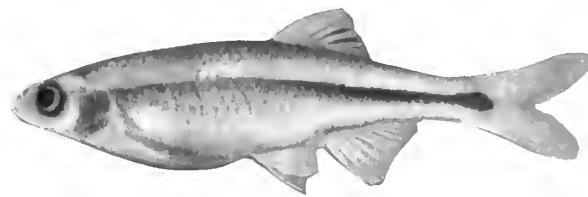
ADULT SIZE: 37-101 mm SL.

BIOLOGY: Outten (1958. J. Elisha Mitchell Sci. Soc. 74:122-34) studied life history in NC, VA, and TN. Individuals often live three years, rarely four. Both sexes first spawn at age II. Spawning observed from 25 May to 28 June at 24-28°C. Eggs laid on undersides of rocks and other surfaces. Insects were principal food item, but small fish occasionally eaten.

Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

***Notropis gibbsi* Howell and Williams**
Tallapoosa shiner

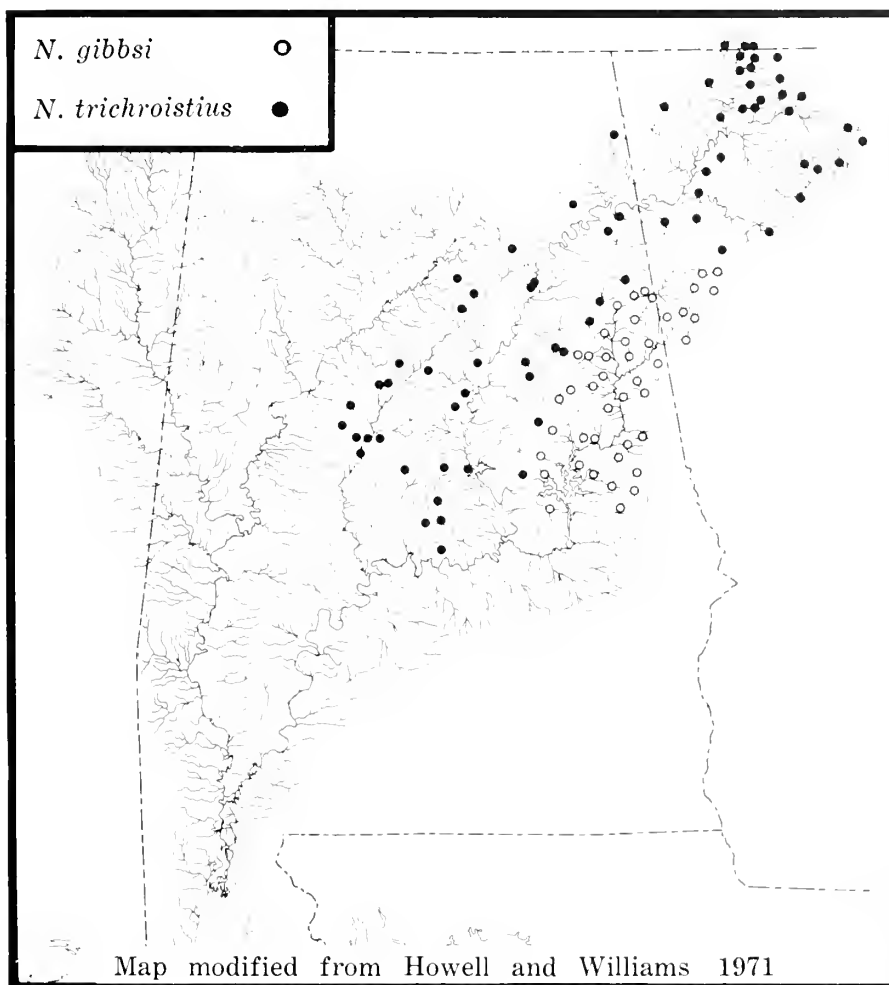
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: Enitachope Creek, tributary to Hillabee Creek, 5.1 km ssw of Ashland, along state hwy. 9, Clay Co., AL (Howell and Williams 1971. *Copeia*:55-64).

SYSTEMATICS: Subgenus *Cyprinella*. Howell and Williams (1971) compared this species with closely related, allopatric *N. trichroistius*. Species reviewed by Gibbs (1955. Ph.D. diss., Cornell Univ.) who regarded it as population of *N. trichroistius*. Howell and Williams (1971) considered these two species most closely related to *N. pyrrhomelas* and *N. xanurus*.

AL: Randolph Co., Tallapoosa River drainage, 49 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Endemic to Tallapoosa River system, Mobile Bay drainage, eastern AL and western GA. One record, evidently an introduction, in tributary of Coosa River, eastern AL. Usually in medium-sized streams, 6-12 m wide, with sand, silt or rock bottom, in water with moderate to swift current below riffles and shoals. Most common cyprinid fish in its area of occurrence.

ADULT SIZE: 77 mm SL maximum

BIOLOGY: No studies published.

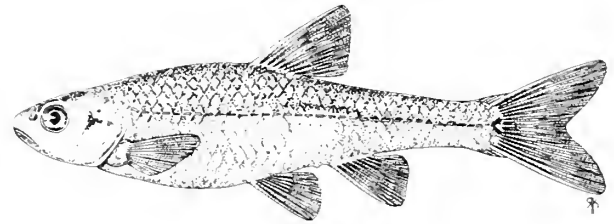
Compiler: C. R. Gilbert. August 1978.

Notropis girardi Hubbs and
Ortenburger
Arkansas River shiner

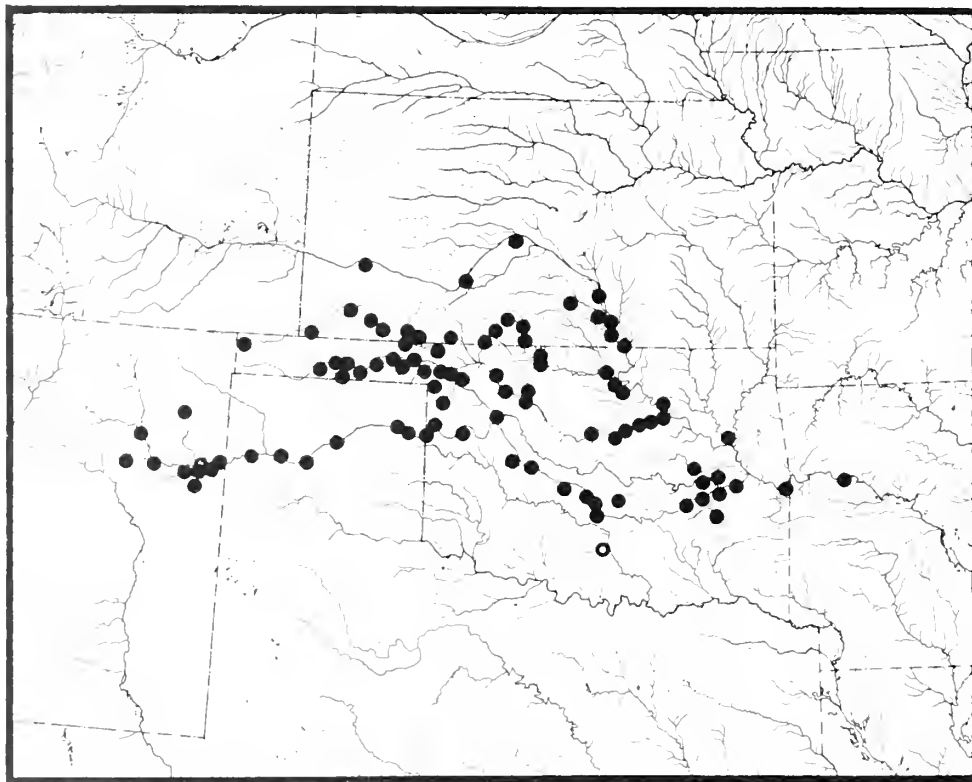
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Cimmaron River, 4.9 km nw of Kenton, Cimmaron Co., OK (Hubbs and Ortenburger 1929. Publ. Univ. Okla. Biol. Surv. 1:17-43).

SYSTEMATICS: Closely related to *N. bairdi* and *N. buccula*, which are endemic to more southerly Red and Brazos river drainages, respectively. These form a close group whose precise relationships to other *Notropis* species are not entirely clear. Detailed inter-specific comparison included in Cross' (1953. Texas J. Sci. 5:252-59) original description of *N. buccula*.



(NCSM)



Open circle transplanted population

DISTRIBUTION AND HABITAT: Endemic to Arkansas River drainage of OK, western AR, southern KS, northern TX, and north-eastern NM. Presumably also in extreme southeastern CO. Cross (1970. Southwest. Nat. 14:370) recorded single individual (presumably an introduction) from Washita River (Red River drainage), Garvin Co., OK. Typically in turbid waters of broad, shallow channels of main streams, over mostly silt and shifting sand bottom. Abundant.

ADULT SIZE: ca. 25-45 mm SL, 54 mm SL maximum.

BIOLOGY: Moore (1944. Copeia: 209-14) published on aspects of reproduction. Spawns mid-July in main stream channel, after which eggs travel with current many miles downstream. Hatching occurs within one day and yolk sac is mostly absorbed by end of third day. Food not recorded but presumably small aquatic invertebrates.

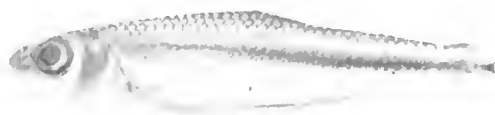
Compiler: C. R. Gilbert. October 1978.

Notropis greeniei Hubbs and
Ortenburger
Wedgespot shiner

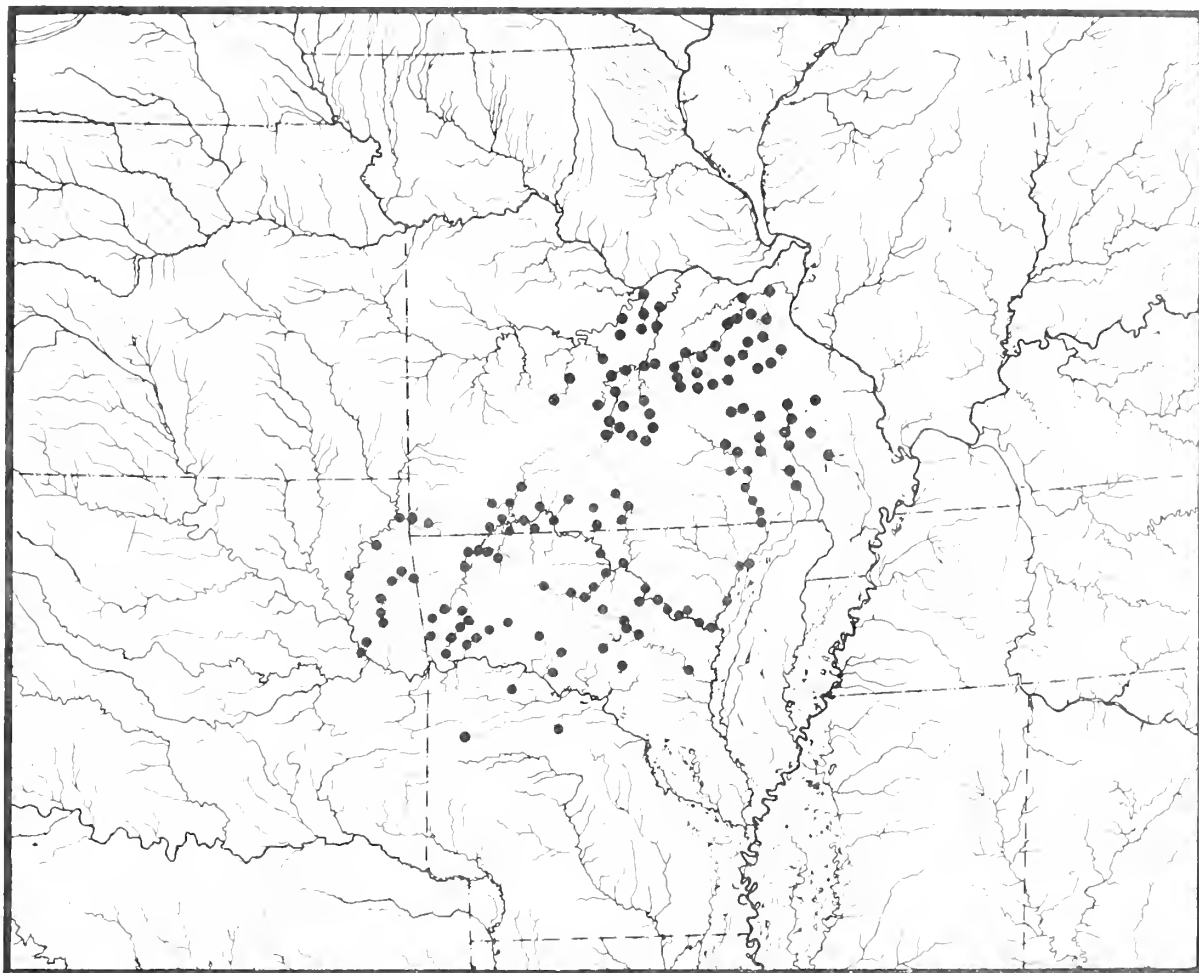
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Elk River (tributary to Neosho River), 11.3 km n of Grove, Delaware Co., OK (Hubbs and Ortenburger 1929. Publ. Univ. Okla. Biol. Surv. 1: 47-112).

SYSTEMATICS: No definitive study; precise relationships uncertain.



AR: Scott Co., Mill Creek, 58
mm SL (NCSM).



DISTRIBUTION AND HABITAT: Ozark Uplands from middle Arkansas River drainage of central AR and northeastern OK; White, Black, and St. Francis river systems of northern AR and southeastern MO; and Meramec, Gasconade, and lower Osage river systems (Missouri River drainage) of eastern MO. Inhabits clear, permanently flowing streams, from medium-sized creeks to moderately large rivers, but never in small headwater creeks. Usually found near riffles or in adjacent parts of pools, over bottom of sand, gravel or rubble. Usually common.

ADULT SIZE: ca. 45-63 mm TL; ca. 75 mm TL maximum.

BIOLOGY: Schools in midwater. Adults in spawning condition collected in MO from late May to late August. Spawns over clear gravel riffles in swift current. Nothing known of growth or food habits. Information from Pflieger (1975. *The Fishes of Missouri*).

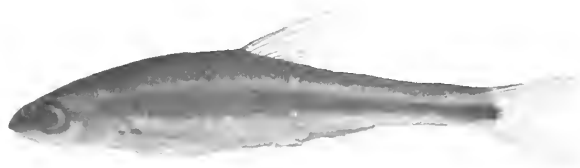
Compilers: C. R. Gilbert and G. H. Burgess.
September 1979.

***Notropis harperi* Fowler**
Redeye chub

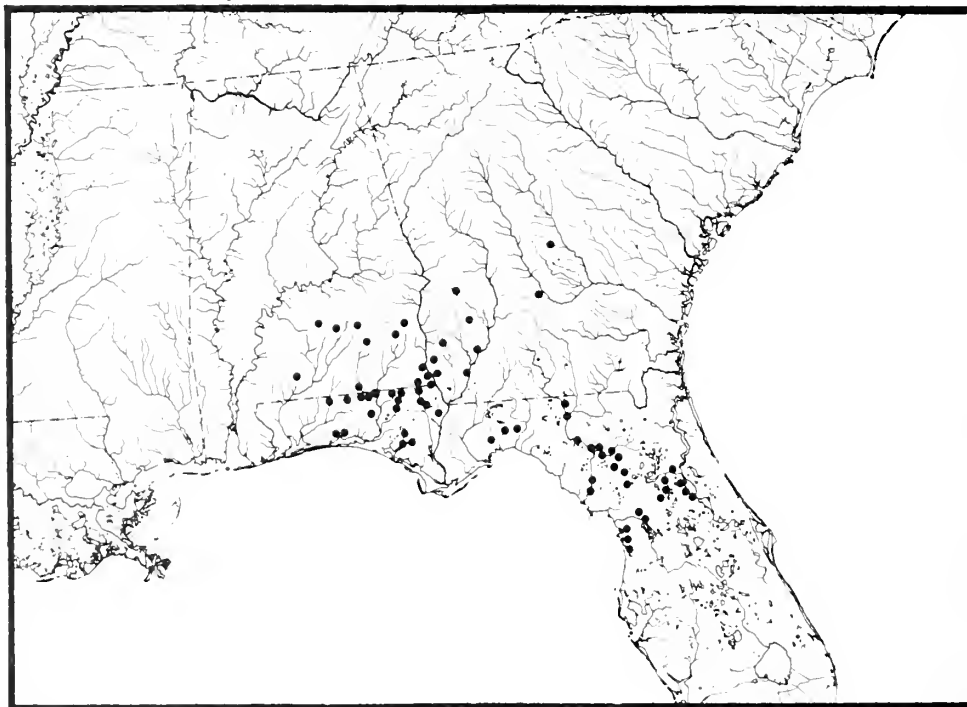
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Small spring ca. 200 m se of Manatee Spring, off Suwannee River, ca. 11.3 km w of Chiefland, Levy Co., FL (Fowler 1941. Proc. Acad. Nat. Sci. Phila. [1940] 92:227-44).

SYSTEMATICS: Uncertain relationships, differing from most *Notropis* in having a barbel at each corner of mouth. On basis of this character it has been referred either to *Erimystax* (Herald and Strickland 1949. Q. J. Fla. Acad. Sci. [1948] 11:99-109) or to *Hybopsis* (Bailey in Harlan and Specker 1951. *Iowa Fish and Fishing*:187-237). Recently re-assigned to *Notropis* by Gilbert and Bailey (1972. Occas. Pap. Mus. Zool. Univ. Mich. 664:1-35). Hubbs and Crowe (1956. Occas. Pap. Mus. Zool. Univ. Mich. 578:1-8) recognized two subspecies, *N. h. subterranea*, and nominate form, but Howell (1960. Ph.D. diss., Univ. Florida) questioned their validity.



FL: Lake Co., Silver Glen Springs, 44 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Escambia River drainage, FL and AL, east to St. Johns drainage, FL, and north to Altamaha drainage, GA. Distribution not continuous within this area, however, and it is absent from all or most of certain major intervening drainages (e.g., Ocklockonee River). Disjunct distribution dictated by species' close restriction to springs and spring runs, where it is often the dominant fish species numerically, particularly toward spring heads. Also occurs underground, thus has found its way into many isolated caves and sinkholes not connected by surface waters.

ADULT SIZE: 25-49 mm SL.

BIOLOGY: Very closely associated with springs, where water temperatures usually range from 20-23° C. Marshall (1947. Ecology 28:68-75) studied aspects of biology and reported food to consist of insects, crustacea, and small fish. Herald and Strickland (1949) found egg numbers in 12 females, 25-31 mm SL, to range from 65-126. Spawning probably occurs throughout year, based on discovery of ripe fish during all months (Marshall 1947).

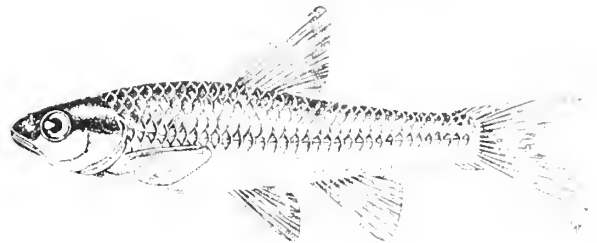
Compiler: C. R. Gilbert. December 1978.

Notropis heterodon (Cope)
Blackchin shiner

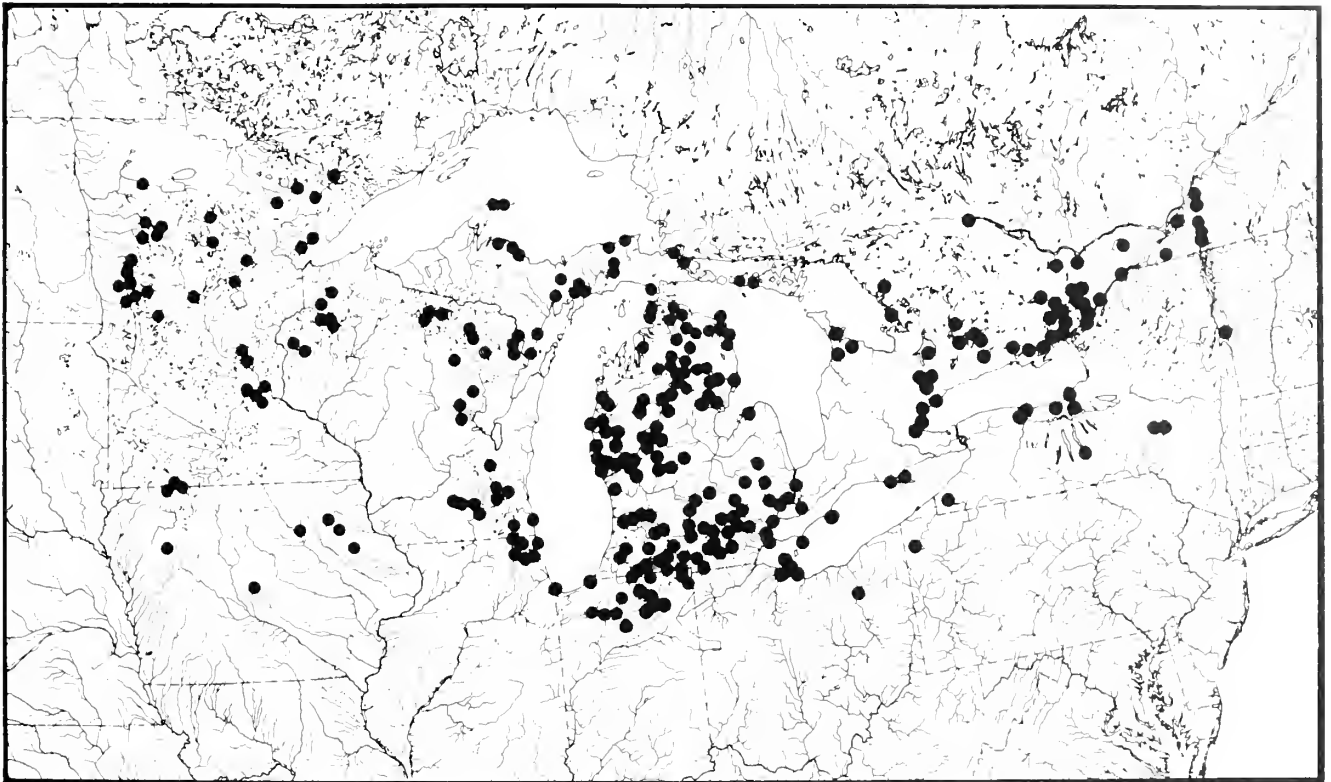
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Lansing and Grosse Isle, MI (Cope 1865. Proc. Acad. Nat. Sci. Phila. [1864] 16:276-85).

SYSTEMATICS: Intraspecific variation not studied. Closely resembles *N. bifrenatus*, and may be rather closely related.



(NCSM)



DISTRIBUTION AND HABITAT: Range centered in Great Lakes and extreme upper Mississippi River basin, in northern United States and southern Canada. Recently entered certain headwaters of Red River of North in MN. Ranges from western MN (and eastern ND?) east to north-central NY. Range in Canada almost entirely confined to southeastern ON and extreme southern QU. Mostly restricted to clear, cool, weedy glacial lakes, where may be extremely common. Disappears rapidly from areas where conditions altered, as in northern OH. Unlike *N. heterolepis*, which occupies similar habitat, does not appear to have extended range far south during glacial maxima.

ADULT SIZE: 51-61 mm TL, 71 mm TL maximum.

BIOLOGY: Considered specialized feeder, usually on cladocerans and flying insects (mostly small dipterans) taken at surface (Keast 1965. Univ. Mich. Great Lakes Res. Div. 13:106-32). Breeding time or behavior unstudied; data listed by Forbes and Richardson (1908. *The Fishes of Illinois*) based on another species. Apparently short lived, most not living beyond two years (Trautman 1957. *The Fishes of Ohio*).

Compiler: C. R. Gilbert. February 1979.

Notropis heterolepis Eigenmann and
Eigenmann
Blacknose shiner

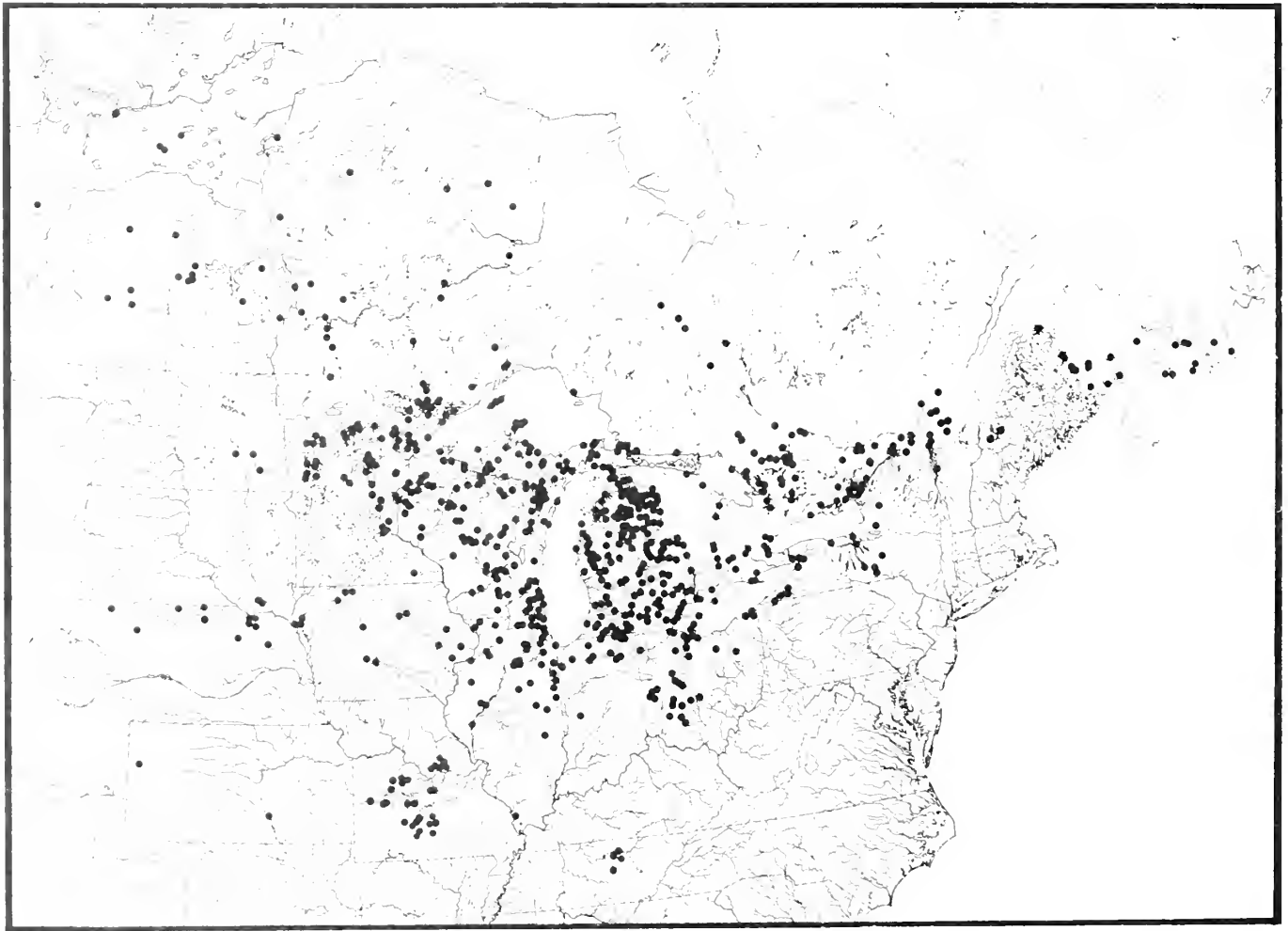
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributary to Qu'Appelle River at Ft. Qu'Appelle, ca. 3.2 km sw of Melville, Saskatchewan, Canada (Eigenmann and Eigenmann 1893. *Am. Nat.* 27: 151-54).

SYSTEMATICS: No comprehensive systematic review of this species exists. Scott and Crossman (1973. *Freshwater Fishes of Canada*) noted wide morphological variation in Canadian populations.



MO: Texas Co., Bender Creek,
39 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Widely distributed. In Canada, occurs from Hudson Bay drainage and Saskatchewan east to Nova Scotia. In United States occurs from ME west to NB. Glacial relict populations once occurred as far south as southern KS (Arkansas River drainage); populations are declining in MO. Extirpated from most of the indicated localities from OH west to IA. Several populations still occur in middle Cumberland River drainage in north-central TN. There is

one (1959) unconfirmed record from the Rough River, KY. Typically in cool, weedy streams and lakes, but northern TN populations are in clear, warm, weedless streams.

ADULT SIZE: 46-101 mm TL.

BIOLOGY: No definitive studies of life history and ecology. Scott and Crossman (1973) summarized available information.

Compiler: C. R. Gilbert. April 1978.

***Notropis hubbsi* Bailey and Robison**
Bluehead shiner

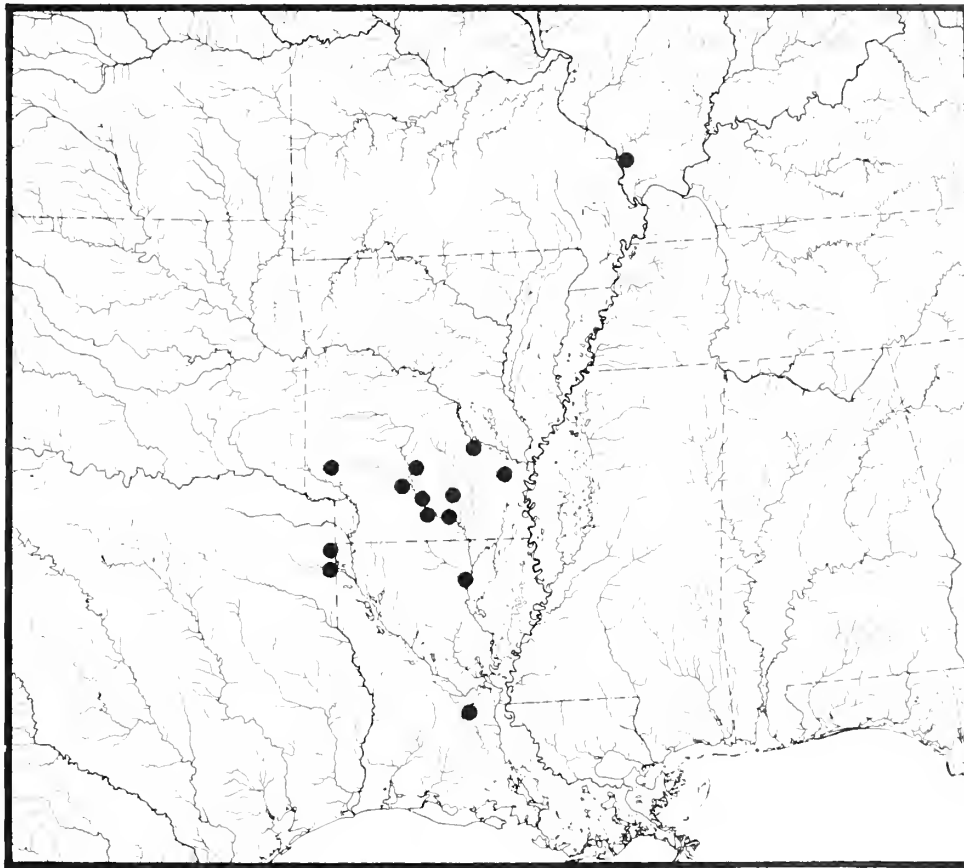
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Locust Bayou, tributary to Ouachita River, 1 km w of Locust Bayou at state hwy. 4 bridge, Calhoun Co., AR (Bailey and Robison 1978. Occas. Pap. Mus. Zool. Univ. Mich. 683:1-21).

SYSTEMATICS: Bailey and Robison (1978) indicated close relationship with *N. welaka*. Relationships of these two to other species of *Notropis* are uncertain.



AR: Calhoun Co., Locust Bayou,
48 mm SL (NCSM).



Map from Bailey and Robison 1978

DISTRIBUTION AND HABITAT: Mississippi River Valley from central LA north to extreme southwestern IL, with all records except IL being west of Mississippi River. No known localities between southwestern IL and central AR. Inhabits quiet backwater areas of small to medium-sized, sluggish streams and oxbow lakes having mud or mud-sand bottom. Water typically tannin-stained, and heavy growth of submergent or semi-emergent vegetation often present. Regarded as very rare species, but this may result in part from inaccessibility of preferred habitat to conventional collecting techniques.

ADULT SIZE: 39-49 mm SL.

BIOLOGY: No detailed studies published.

Compiler: C. R. Gilbert. August 1978.

Notropis hudsonius (Clinton)
Spottail shiner

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Hudson River, NY (Clinton 1824. Ann. Lyceum Nat. Hist. N.Y. 1:49-50).

SYSTEMATICS: Highly variable species. Atlantic slope population (particularly on southern portion) lacks distinct caudal spot and has different average pharyngeal tooth count and slimmer body as compared to western (trans-Appalachian) populations. Seaman (1968. M.Sc. thesis, Univ. Florida) studied systematics and found fairly even clinal gradation of morphological characters from southern Atlantic slope north, and from there to northwestern limits of range. He also found confusing overlap of pigmentary characters (mainly caudal spot) on northern Atlantic slope. These factors precluded recognition of distinct taxa, even at subspecific level. Additional systematic studies, possibly employing biochemical techniques, appear called for.

DISTRIBUTION AND HABITAT: One of most widely ranging North American freshwater fishes. On Atlantic slope, from Altamaha drainage, GA, north to Connecticut and Thames drainages (CT, MA, and NH). Has entered Chattahoochee system (Apalachicola drainage), GA, presumably by stream capture from Savannah drainage. Throughout most of St. Lawrence and Great Lakes basin, upper eastern Mississippi River basin, and in northwestern Canada, to near mouth of Mackenzie River. On Atlantic slope occurs in wide range of habitats, from large, sluggish coastal rivers and brackish water up to 10.7 ppt (Jones et al. 1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 1) to small, clear, rapidly-flowing montane streams. Western populations more closely restricted to large rivers and lakes, usually over sandy or rocky shallows with scant vegetation. Usually common and sometimes abundant.

ADULT SIZE: 75-114 mm TL, 132 mm TL maximum.



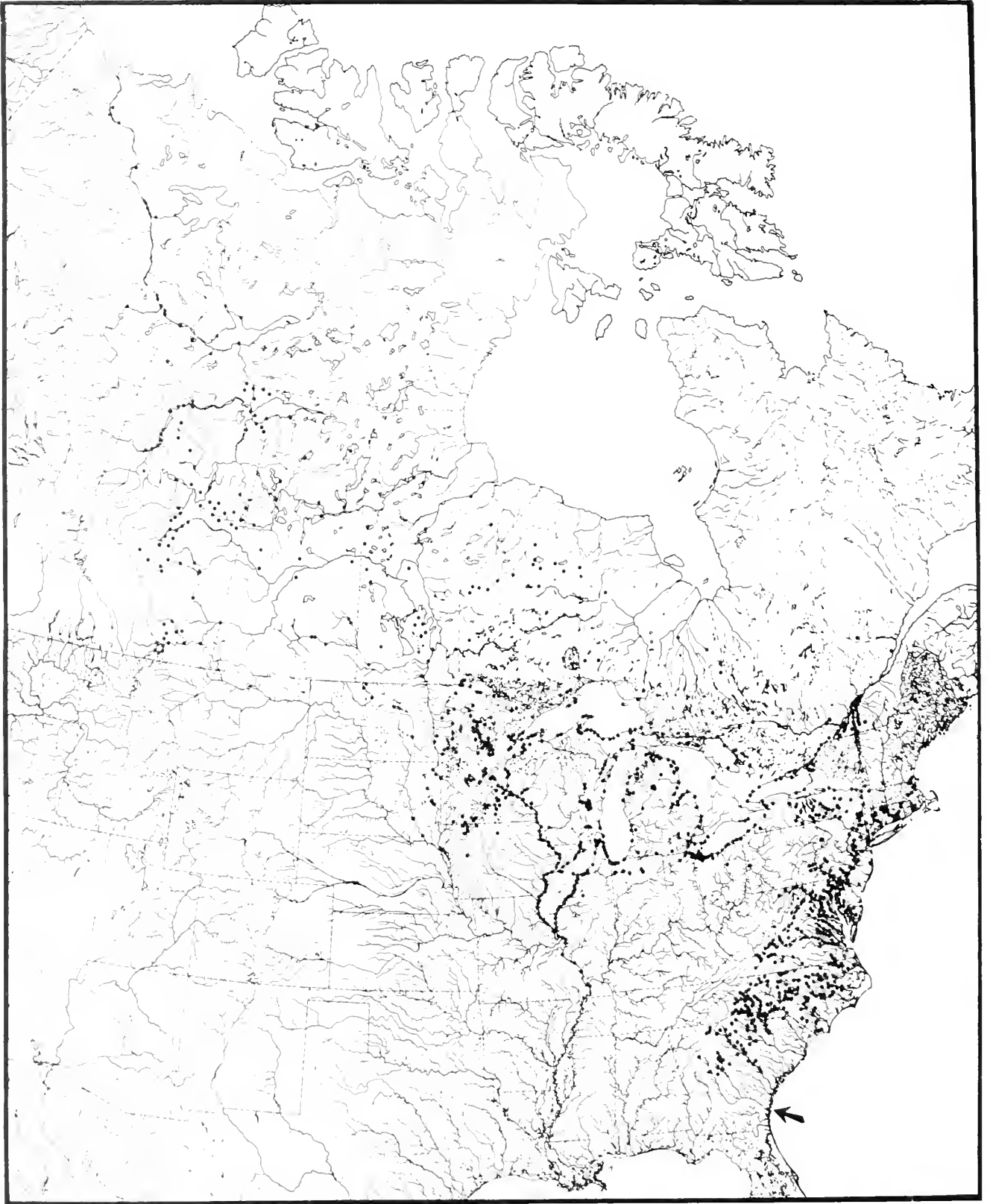
MD: Harford Co.,
Susquehanna River, 75 mm
SL (NCSM).



See map on next page

BIOLOGY: Shapiro (1975. Mass. Coop. Fish. Res. Unit. Publ. 43:1-47) provided complete bibliography of species. Adams and Hankinson (1928. Roosevelt Wild Life Ann. 1:235-548), McCann (1959. Trans. Am. Fish. Soc. 88:336-43) and Scott and Crossman (1973. *Freshwater Fishes of Canada*) studied or reviewed biology in NY, IA, and Canada, respectively. Spawns in spring or early summer, precise date depending on latitude and temperature. In lake populations, at least, this occurs over shallow, sandy shoals. Maximum age four years in MN (Smith and Kramer 1964. Trans. Am. Fish. Soc. 93:35-45), only three years (and usually two) in IA (McCann 1959). Eats insects, crustaceans, and often large amounts of filamentous algae (McPhail and Lindsey 1970. *Freshwater Fishes of Northwestern Canada and Alaska*). Important forage species in many areas.

Compilers: C. R. Gilbert and G. H. Burgess.
August 1979.



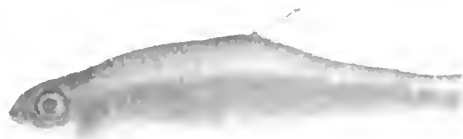
Distribution of spottail shiner, *Notropis hudsonius*

Notropis hypselopterus (Günther)
Sailfin shiner

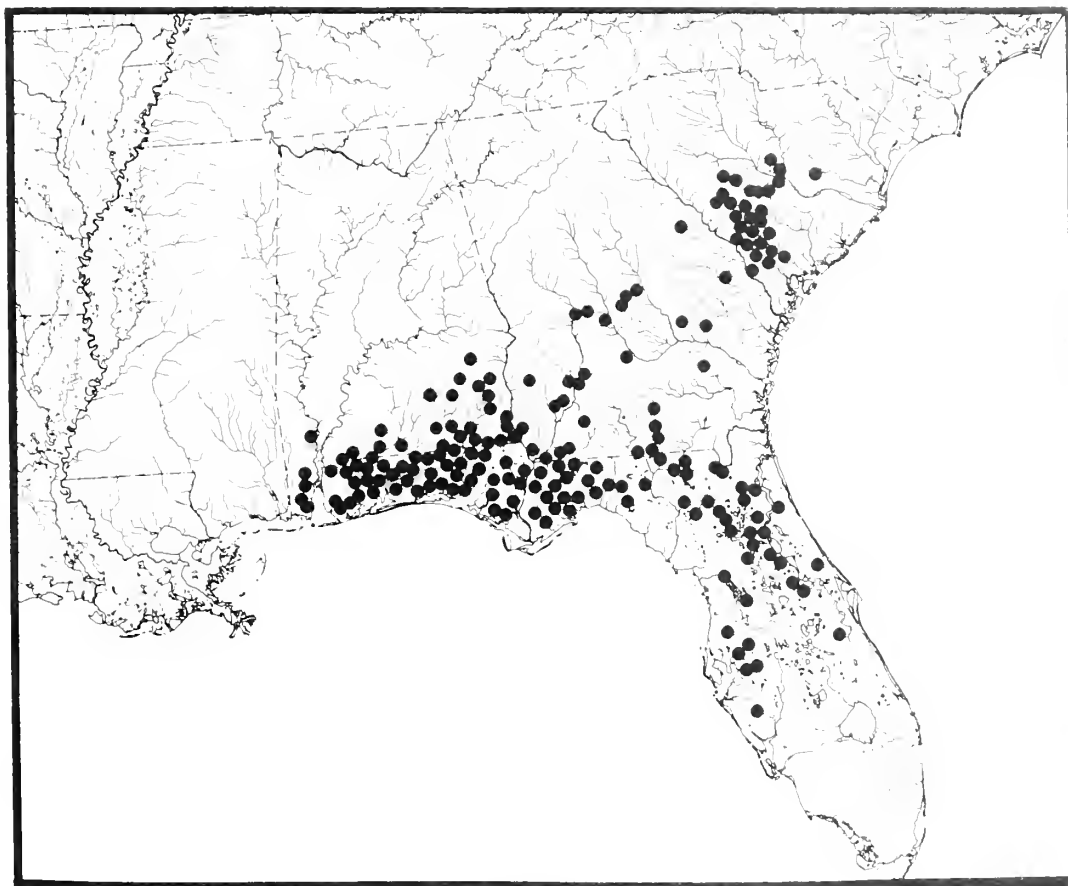
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Mobile, AL (Günther 1868. *Catalogue of the Fishes in the British Museum* 7:1-512).

SYSTEMATICS: Subgenus *Pteronotropis*. No detailed systematic study published, although Suttkus (1951. Ph.D. diss., Cornell Univ.) studied variation in species. Morphologically variable; two subspecies recognized, *N. h. hypselopterus* and *N. h. stonei*, the latter sometimes considered a species (Bailey and Suttkus 1952. *Occas. Pap. Mus. Zool. Univ. Mich.* 542:1-15; Suttkus 1955. *Tulane Stud. Zool.* 3:85-100). Closest relative *N. euryzonus*, with *N. signipinnis* slightly more distantly related.



AL: Barbour Co., Choc-tawhatchee River system, 47 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: South-eastern Gulf and Atlantic Coastal Plain, from western tributaries of lower Tombigbee River (Mobile Bay basin), AL, east to Black River system, SC (tributary to extreme lower Peedee River drainage). South in peninsular FL to upper St. Johns River drainage, and (on west coast) to Myakka River system. Precise ranges of two subspecies not clearly defined (in publication), but *N. h. stonei* considered to occur in northern GA and in SC. In small to moderate-sized, shallow, flowing streams with clear,

white to brown water. Substrate usually of sand and detritus, and some aquatic vegetation may be present. Generally common.

ADULT SIZE: ca. 50 mm SL maximum.

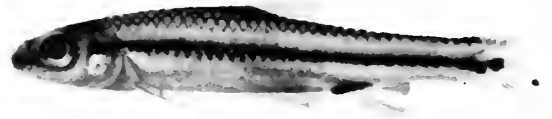
BIOLOGY: Nothing published.

Compilers: C. R. Gilbert and G. H. Burgess.
August 1979.

Notropis hypsilepis Suttkus and
Raney
Highscale shiner

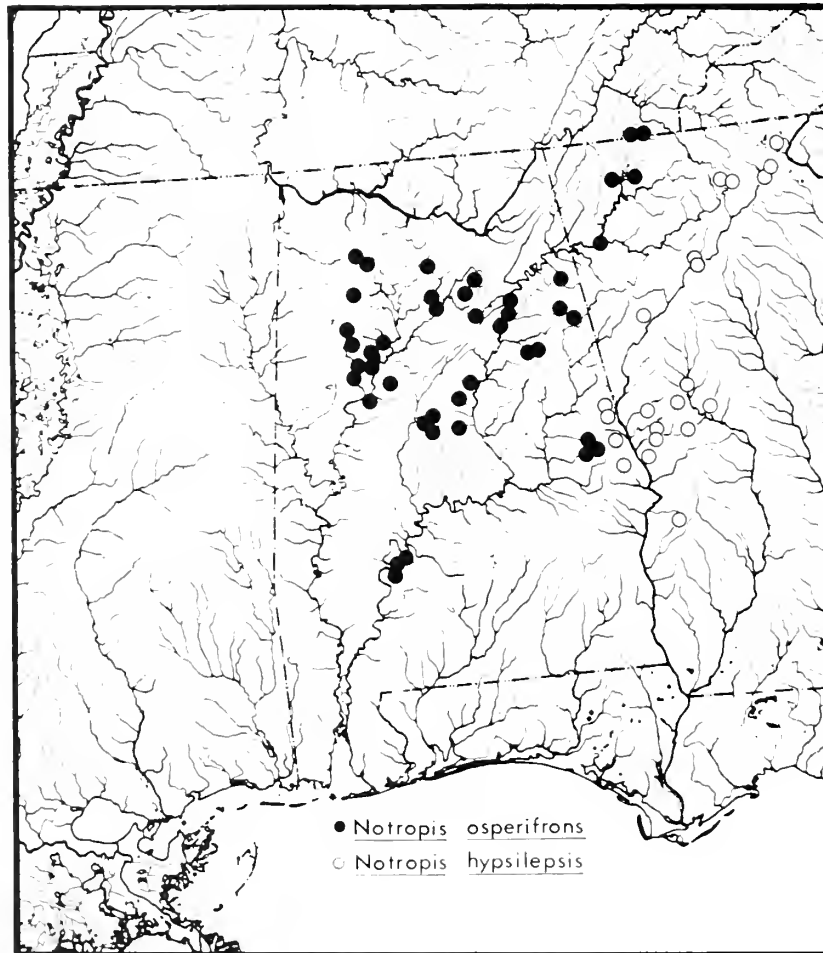
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributary to Soque River, 2.4 km w Clarksville, Habersham Co., GA (Suttkus and Raney 1955, Tulane Stud. Zool. 2:161-70).



SYSTEMATICS: Swift (1970, Ph.D. diss., Florida State Univ.) studied systematics. Member of *N. texanus* species group, which includes *N. asperifrons*, *N. chalybaeus*, *N. petersoni*, and *N. texanus*.

AL: Lee Co., Chattahoochee River system, 32 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Chattahoochee and Flint river systems (Apalachicola drainage), AL and GA; possibly native to upper Savannah drainage, GA. Probably benthic; often occurring near stream mouths (Swift 1970). Closely associated with sandy substrate (Ramsey pers. comm). Generally not very common.

ADULT SIZE: 35-51 mm SL.

BIOLOGY: Little known; spawns March to June, based on museum specimens (Suttkus and Raney 1955; Swift 1970).

Compiler: C. C. Swift. January 1979.

Notropis jemezanus (Cope)
Rio Grande shiner

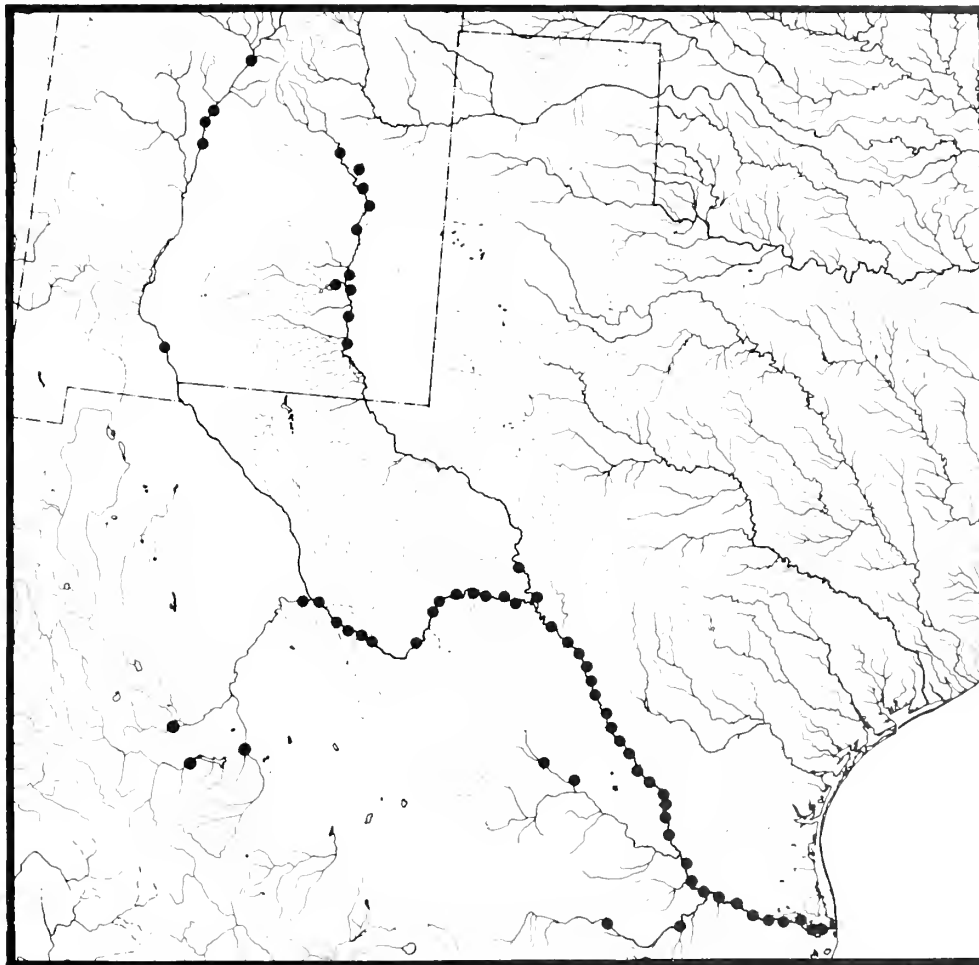
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio Grande, at San Ildefonso, ca. 16 km e of Los Alamos, Santa Fe Co., NM (Cope in Cope and Yarrow 1875. Geol. and Geogr. Explor. & Surv. W of 100th Mer. 5:637-700).

ILLUSTRATION

NOT AVAILABLE

SYSTEMATICS: Subgenus *Notropis*. Although exact relationships within subgenus have not been determined, *N. atherinoides* and *N. oxyrhynchus* are geographically closest and both also occur in TX. Intraspecific variation not studied.



DISTRIBUTION AND HABITAT: Endemic to Rio Grande drainage, from just above mouth of main river in TX and Mexico to headwaters of Rio Grande and Pecos rivers, northern NM. Also in major tributaries in Mexico (Rio San Juan, Rio Salado and Rio Conchos). Current absence from middle Rio Grande between El Paso and Presidio, TX, substantiated by Hubbs et al. (1977. Symposium on importance, preservation and management of riparian habitat, Tucson, AZ, 91-97), resulted from local irrigation practices. Uneven distribution in main Rio Grande of NM also appears real, inasmuch as area has

been intensively sampled during past 40 years. Apparently common in lower half of main Rio Grande (Robinson 1959. Copeia: 253-56). Typically in large, open, weedless rivers or large creeks with bottom of rubble, gravel and sand, often overlain with silt.

ADULT SIZE: Not determined. Attains at least 60 mm SL.

BIOLOGY: Not studied.

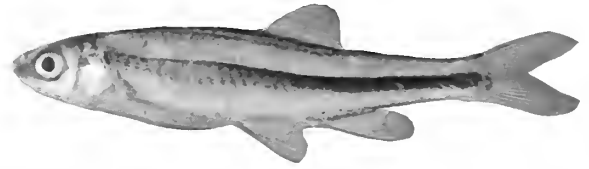
Compiler: C. R. Gilbert. October 1978.

Notropis leedsi Fowler
Bannerfin shiner

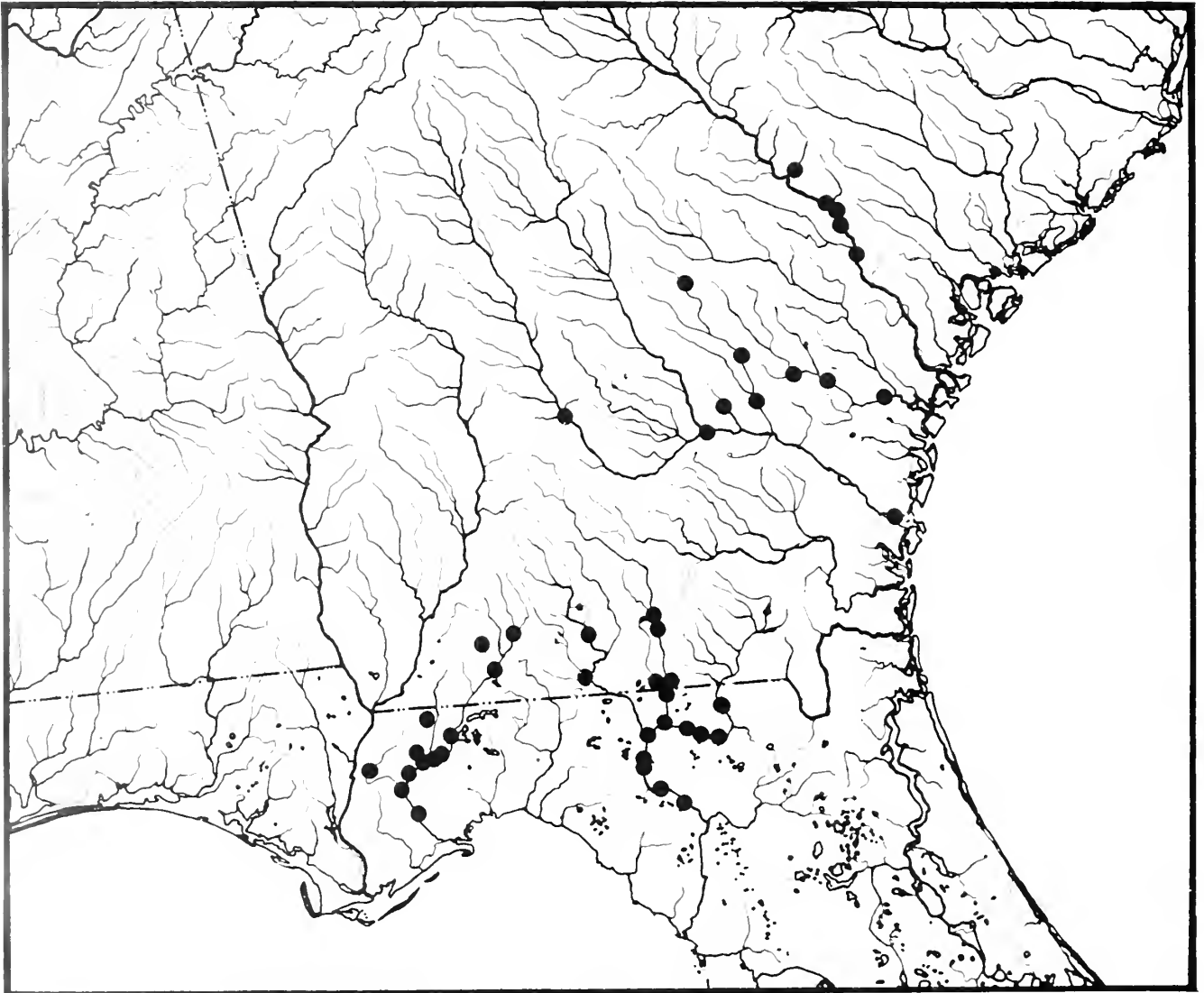
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Ochoopee River, ca. 4 km n of Oak Park, Emanuel Co., GA (Fowler 1942. Not. Nat. 107:1-11).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1955. Ph.D. diss., Cornell Univ.) reviewed species and subsequently (1957. Copeia:185-95) discussed relationships. Most closely related to *N. callisema* and *N. callitaenia*, somewhat less so to *N. niveus*.



GA: Echols Co., Alapaha River, 48 mm SL (J.L. Harris).



Map modified from Gibbs 1955

DISTRIBUTION AND HABITAT: From Ochlockonee and Suwannee river drainages, FL, north to Savannah River drainage, GA and SC. Confined almost entirely to channels of larger, sand-bottomed Coastal Plain streams. Not generally regarded as common, but preferred habitat largely inaccessible to sampling.

ADULT SIZE: ca. 80 mm SL maximum.

BIOLOGY: No studies published.

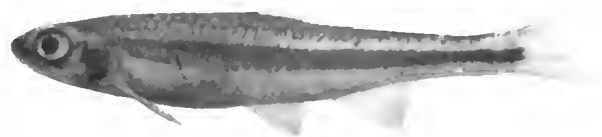
Compiler: C. R. Gilbert. August 1978.

Notropis leuciodus (Cope)
Tennessee shiner

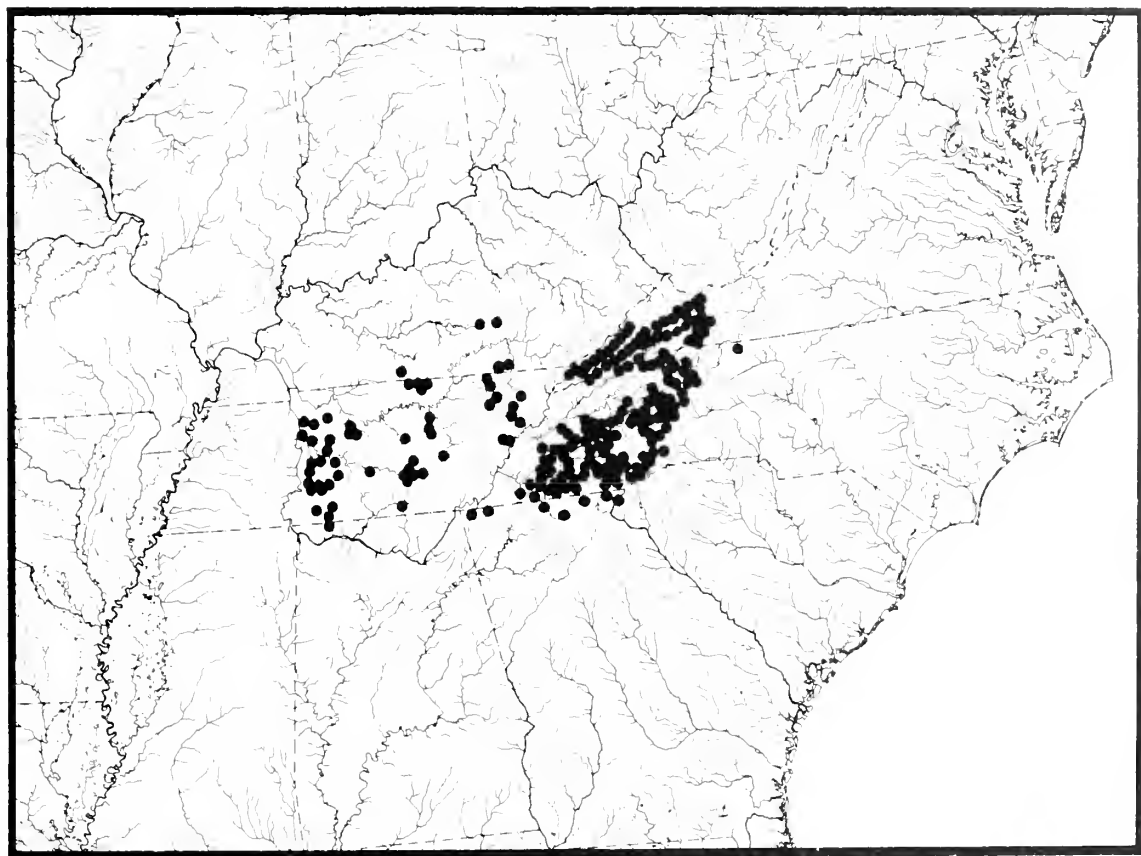
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Holston River, VA (Cope 1868. Proc. Acad. Nat. Sci. Phila. [1867] 19:156-66).

SYSTEMATICS: Subgenus *Hydrophlox*. Considered by Swift (1970. Ph.D. diss., Florida State Univ.; 1971. Diss. Abstr. 31B: 3081), who reviewed subgenus, to be most closely related to *N. nubilus* and *N. chrosomus*.



TN: Blount Co., Tennessee
River system, 55 mm SL
(Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Throughout most of Tennessee River drainage in AL, GA, TN, NC, and VA; Cumberland River drainage in TN and KY; and parts of Green River drainage (mostly Barren River system) in TN and KY. Presence in upper Savannah River drainage, GA and NC, considered result of natural stream capture from Little Tennessee River. Occurrence in New River system (Kanawha River drainage), VA and NC, believed due to human introduction. Very com-

mon, particularly in Tennessee drainage in cool, usually clear streams with gravel-rubble substrate.

ADULT SIZE: 68 mm SL maximum.

BIOLOGY: No studies published.

Compilers: C. R. Gilbert and G. H. Burgess,
October 1979.

***Notropis lirus* (Jordan)**
Mountain shiner

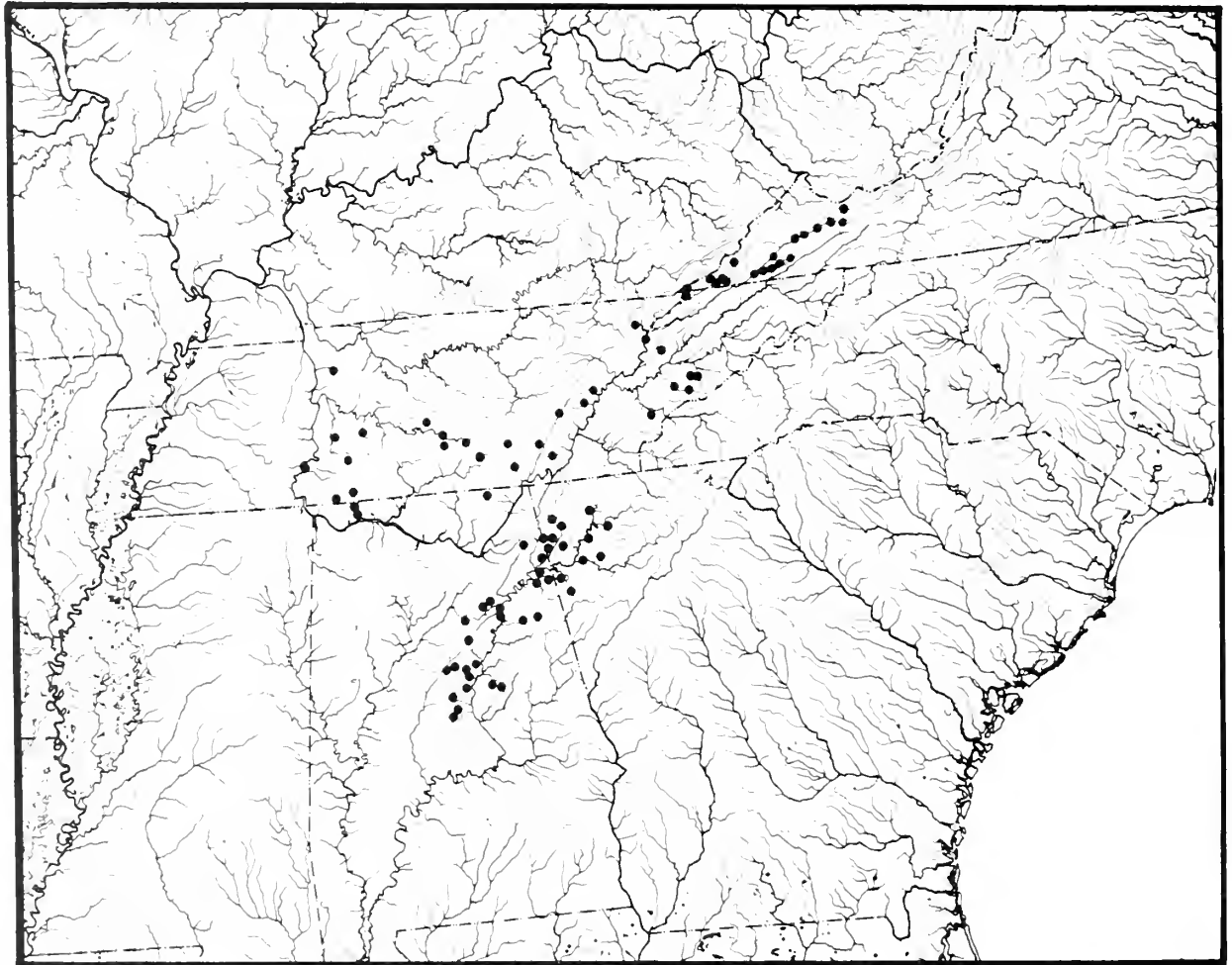
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Etowah River, Coosa River system, near Rome, Floyd Co., GA (Jordan 1877. Ann. N. Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Subgenus *Lythrurus*. Most closely related to *N. ardens* (Snelson 1972. Bull. Fla. State Mus. Biol. Sci. 17:1-92). Snelson (in press, Copeia) studied systematics of species. Populations locally variable but no subspecies recognized.



VA: Tazewell Co., Clinch River, male, 55 mm SL (F. F. Snelson).



Map from Snelson (in press, Copeia)

DISTRIBUTION AND HABITAT: Primarily in small to medium-sized streams above Fall Line in Tennessee and Alabama river drainages in AL, GA, TN, and VA. In Tennessee drainage, from Tazewell Co., VA, downstream to Houston Co., TN. In Alabama drainage rare outside Coosa River system. Typically occupies clear flowing, riffle-pool type streams with moderate gradients and bottom materials ranging from sand-gravel to rubble-boulder. Generally uncommon, occurring in small, widely scattered populations.

ADULT SIZE: 35-55 mm SL.

BIOLOGY: Little known. Based on tuberculation, peak spawning activity appears to be in May and June. No sexual dimorphism in adult size. Hybridizes with *N. b. bellus* in upper Cahaba River system.

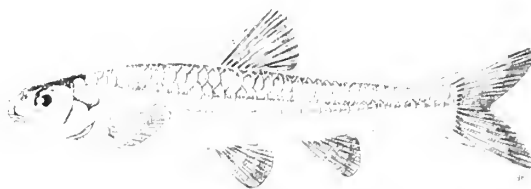
Compiler: F. F. Snelson, Jr. September 1978.

Notropis longirostris (Hay)
Longnose shiner

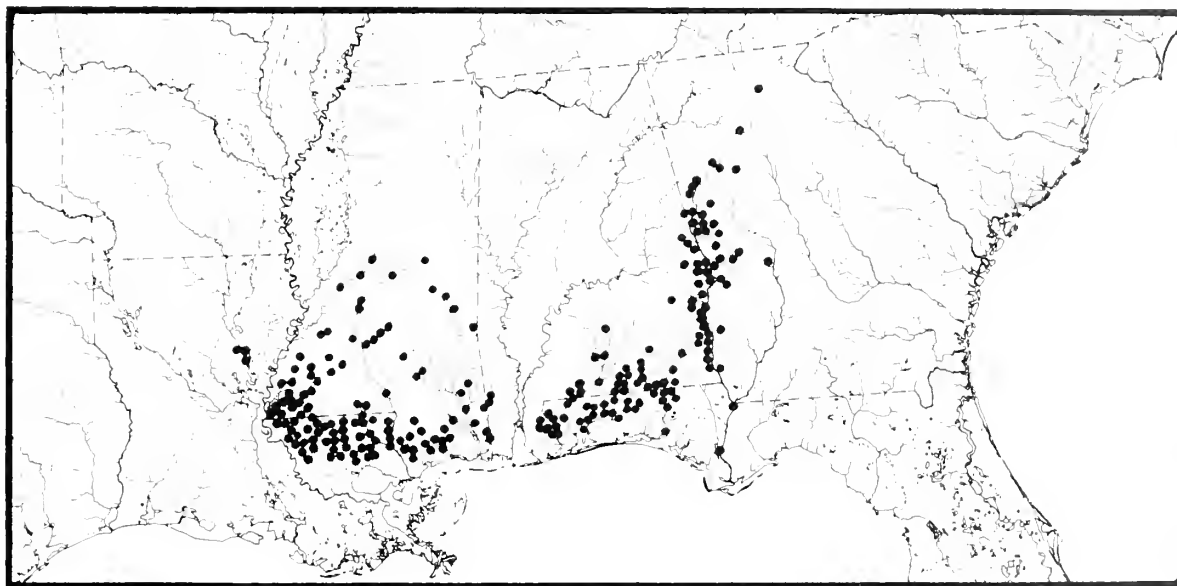
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Chickasawhay River, at Enterprise, Clarke Co., MS (Hay 1881. Proc. U.S. Natl. Mus. [1880] 3:488-515).

SYSTEMATICS: Forms closely related species group with *N. sabiniae* and an undescribed species occurring in Mobile Bay drainage and in several independent tributaries to Mississippi River. R. D. Suttkus is reviewing systematics of group.



(NCSM)



DISTRIBUTION AND HABITAT: Lower Mississippi River basin, LA and MS, east to Apalachicola River drainage, FL, AL, and GA, and upper Altamaha River drainage, GA (Ramsey 1965, Ph.D. diss., Tulane Univ.). In Mississippi River basin, ranges north at least to Black River drainage, MS. All Mississippi basin records from eastern tributaries, except those reported by Douglas (1974, *Freshwater Fishes of Louisiana*) from small section of lower Ouachita River drainage, LA. Distribution appears to be uniquely disjunct, and it is replaced in Mobile Bay drainage by closely related, undescribed species (Smith-Vaniz 1968, *Freshwater Fishes of Alabama*) that also occurs in Hatchie and Yazoo river drainages of TN and MS. Distributional relationships of *N. longirostris* and the undescribed species yet to be clearly defined. All three congeners ecologically restricted to shallow flowing streams with shifting sand substrate. Frequently occurs syntopically with *Ericymba buccata*, but seems to prefer slightly shallower water than that species (Hubbs and Walker 1942, Copeia: 101-04). Usually common to abundant.

ADULT SIZE: 26-52 mm SL.

BIOLOGY: Hubbs and Walker (1942) reported on reproduction; Heins and Clemmer (1976, J. Fish Biol. 8:365-80) on reproduction, age and growth; and Heins and Clemmer (1975, Am. Midl. Nat. 94: 284-95) on food and general ecology. Breeding may occur from late March to October, with reproductive peaks in March-April and early July. No size-related sexual dimorphism noted, but in mating pairs males appear somewhat larger. Spawning usually occurs on edges of flowing pools, above shoal areas. Males patrol small, constantly shifting territory, and spawning occurs over sand bottom. Definite spawning redd not constructed or dug. Most individuals live only 1-1.5 years. Dominant food items are dipteran larvae and newly-emerged adults, as well as other insects. Seasonal changes in food occur, particularly among adults.

Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Notropis lutipinnis (Jordan and
Brayton)
Yellowfin shiner

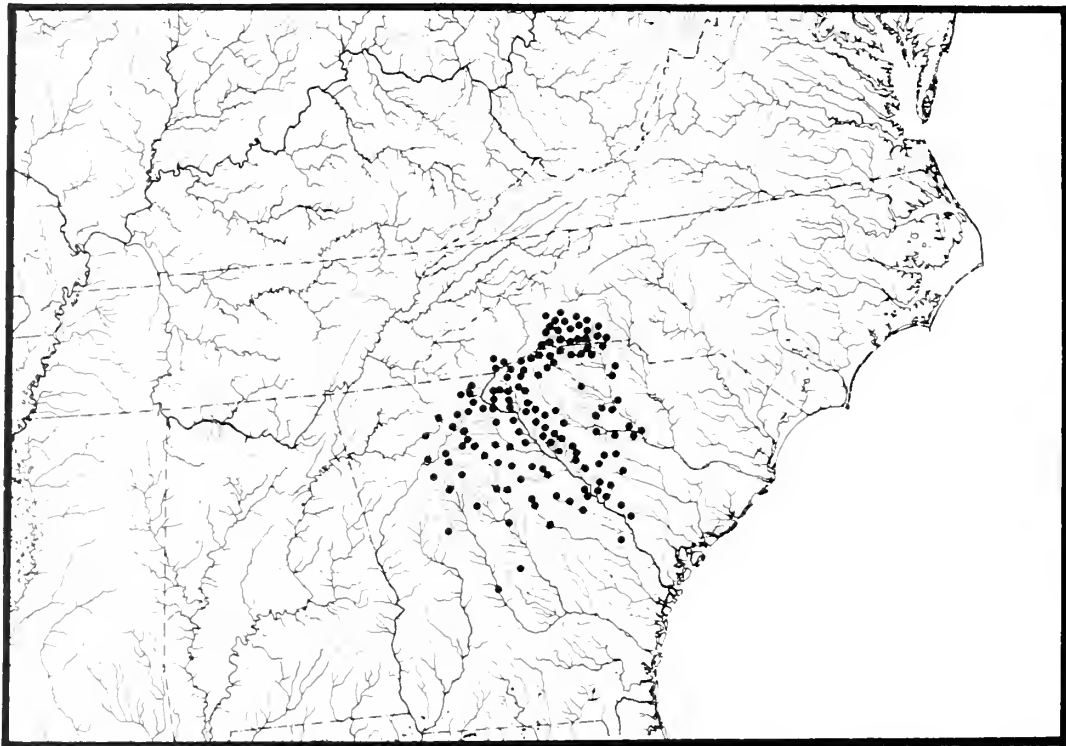
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Headwaters of Oconee River (at Sulphur Springs and Fuller's Mills), Hall Co., GA (Jordan and Brayton 1878. Bull. U.S. Natl. Mus. 12: 1-95).

SYSTEMATICS: Subgenus *Hydrophlox*. Member of *N. rubricroceus* species group, which also includes *N. chiliticus*, *N. baileyi*, and *N. chlorocephalus* (Swift 1971. Diss. Abstr. 31B: 3081). Last species is closest relative, and relationships of two are being studied by D. J. Moore (Univ. Florida).



GA: Crawford Co., Culpepper Creek, 51 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Altamaha to Santee River drainage, GA, SC, and NC. Also in extreme headwaters of Chattahoochee River system (Apalachicola River drainage) and Coosa River drainage, GA (Bryant et al 1979. Southeast. Fish. Counc. Proc. 2: 1-4); possibly native in both drainages. Usually in small, clear headwater creeks, where often abundant.

ADULT SIZE: 60 mm SL maximum.

BIOLOGY: No studies published.

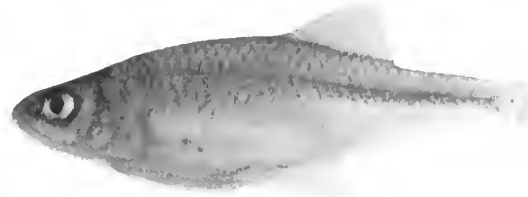
Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

Notropis lutrensis (Baird and Girard)
Red shiner

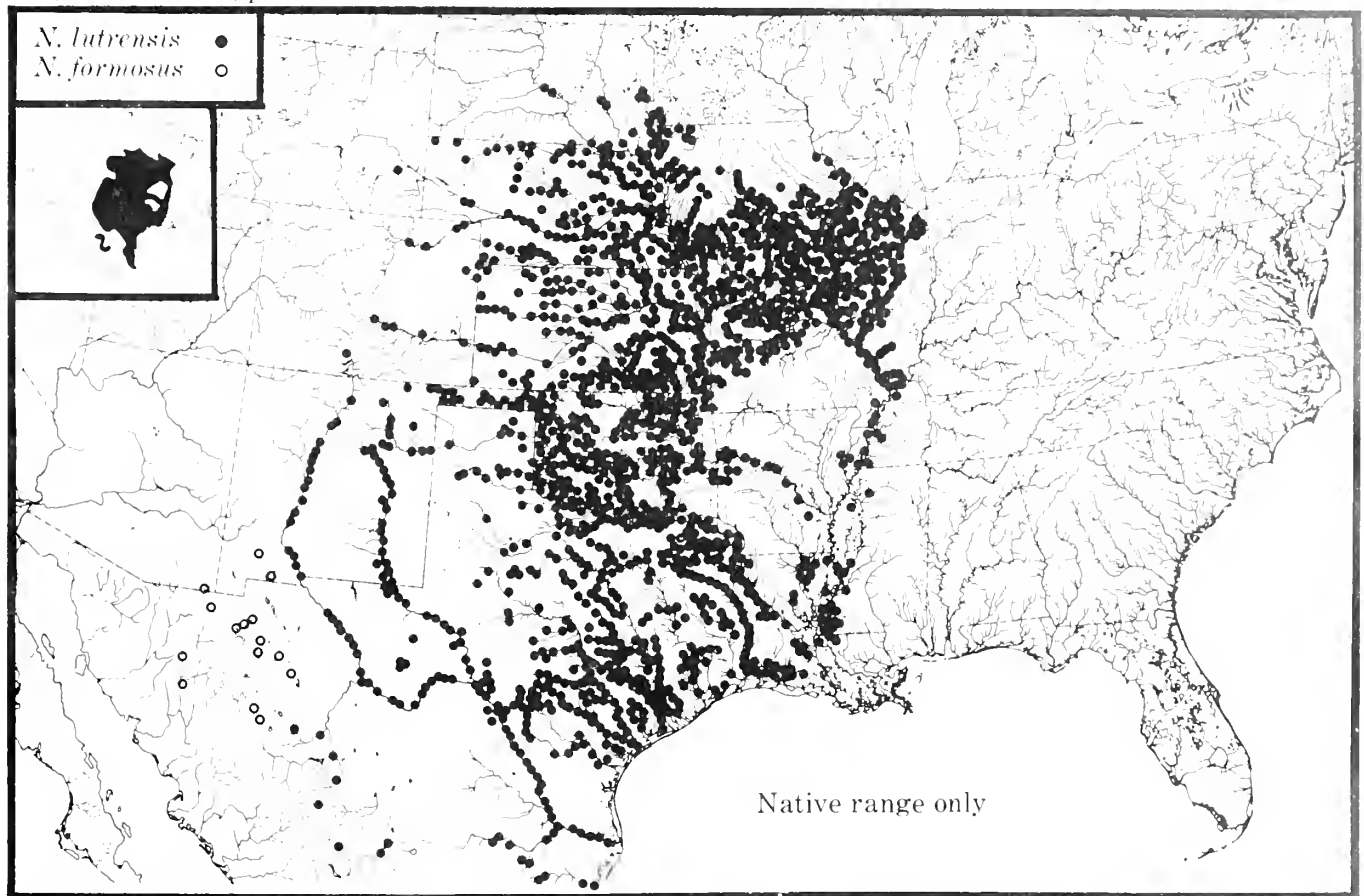
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Otter Creek, tributary of North Fork Red River, Tillman Co., OK (Not AR) (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. [1852-53] 6:390-92).

SYSTEMATICS: Subgenus *Cyprinella*. Highly variable; numerous subspecies in Mexico (Contreras-B. 1975. Ph.D. diss., Tulane Univ.), probably three subspecies in United States. Hybrid swarms with *N. venustus* reported by Hubbs and Strawn (1956. Evolution 10: 341-44) and with *N. spilopterus* by Page and Smith (1970. Trans. Ill. State Acad. Sci. 63:264-72). *Notropis lepidus* = *N. lutrensis* (intergradation; Clark Hubbs, pers. comm).



NM: Quay Co., Canadian River, 46 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Mississippi and Gulf drainages from SD and IL through northern Mexico. Introduced throughout Colorado River basin and in NC; extended range to northeast this century. Often most abundant minnow in wide variety of low-gradient habitats, especially back-waters, creek mouths and medium-sized streams with sand/silt bottoms. Uncommon or absent in clear, high-gradient streams.

ADULT SIZE: 24-75 mm SL.

BIOLOGY: Summary in Cross (1967. *Handbook of Fishes of Kansas*); life history in Laser

and Carlander (1971. Iowa J. Sci. 45:557-62), Cavin (1972. M.S. thesis, Univ. Kansas) and Saksena (1962. Copeia:539-44). Reproduction studied by Farringer and Echelle (1979. Trans. Am. Fish. Soc. 108:271-76) and Mineckley (1972. Southwest. Nat. 17: 101-03). Foods reported by Hale (1963. Okla. Acad. Sci. [1962] 43:125-29), habitat selection by Matthews and Hill (1979. Copeia:70-81), and tolerance by Matthews and Hill (1977. Southwest Nat. 22:89-98) and Matthews and Maness (1979. Am. Midl. Nat. 102:374-77)

Compiler: W. J. Matthews. November 1979.

Notropis maculatus (Hay)
Taillight shiner

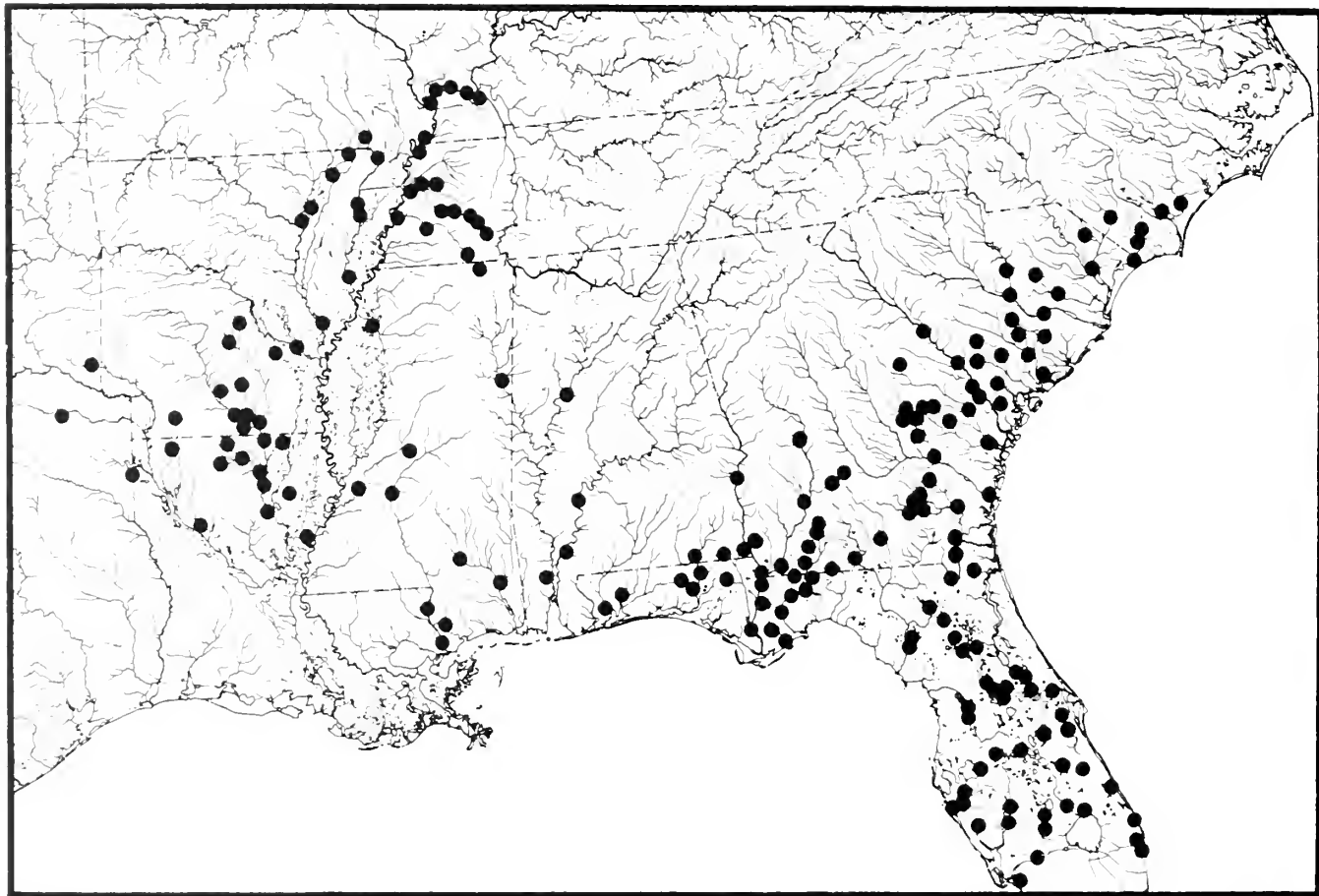
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Chickasawhay River (and tributaries), near Enterprise, Clarke Co., MS (Hay 1881. Proc. U.S. Natl. Mus. 3:488-515).

SYSTEMATICS: No comprehensive systematic review of this species has been published. Gilbert and Bailey (1972. Occas. Pap. Mus. Zool. Univ. Mich. 664:1-35) hypothesized a close relationship between this species and *N. emiliae*.



FL: Polk Co., Lake Parker, 62.5 mm SL (Gilbert and Bailey 1972).



DISTRIBUTION AND HABITAT: Restricted to lower Mississippi Valley, Gulf slope, and southeastern Atlantic slope, below Fall Line. Ranges from Cape Fear River drainage in southeastern NC, south throughout most of peninsular FL and west to Red River drainage in LA, extreme southeastern OK and extreme northeastern TX, north to extreme western KY and southeastern MO. Typically in large, sluggish, mud-bottomed streams and lakes, usually with some aquatic vegetation. Common in suitable habitats throughout much of range, particularly along Gulf and southeastern Atlantic slope.

ADULT SIZE: 48-63 mm SL.

BIOLOGY: Cowell and Barnett (1974. Am. Midl. Nat. 91:282-93) studied life history in central FL, and Burr and Page (1975. Trans. Kentucky Acad. Sci. 36:71-74) published observations on life history in western KY. Has a protracted breeding season in FL (March to October), but breeds from March to May in the north. In FL, algae and cladocerans numerically comprised more than 90% of the food ingested; volumetrically, cladocerans and insect larvae comprised 90% of food. Beach (1974. Fla. Sci. 37:5-16) reported on food and reproduction.

Compiler: C. R. Gilbert. May 1978.

Notropis mekistocholas Snelson
Cape Fear shiner

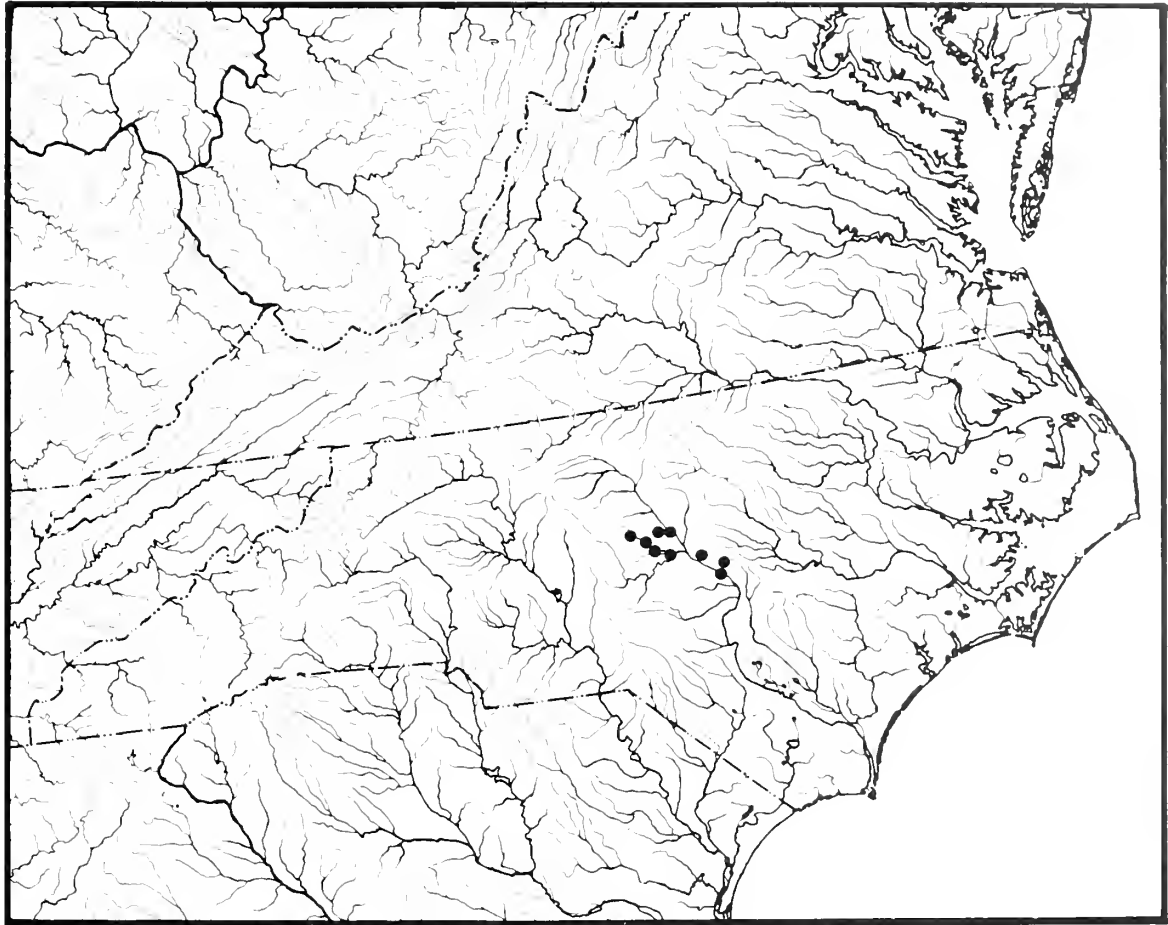
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rocky River at state hwy. 902 bridge, 11.2 km sw of Pittsboro, Cape Fear River drainage, Chatham Co., NC (Snelson 1971. Copeia: 449-62).

SYSTEMATICS: Closely related to *N. procerus* and *N. stramineus*. Unusual in the genus in possessing black parietal peritoneum and nearly unique in *Notropis* in having an elongate, convoluted intestine (found also in *N. nubilus*).



NC: Chatham Co., Robeson Creek, female, 45 mm SL (F. Snelson).



DISTRIBUTION AND HABITAT: Endemic to Cape Fear drainage in NC, where limited to very small area just above Fall Line near confluence of Deep and Haw rivers. Known from four streams in two counties, but recent collections only from two of these (Rocky River and Robeson Creek). Distribution more restricted than any other described *Notropis*. Occupies medium-sized creeks to small rivers with moderate gradients and riffles alternating with long, deep pools. Stream bottoms a mixture of sand-gravel, rubble, and boulders. Usually uncommon.

ADULT SIZE: 45-60 mm SL.

BIOLOGY: Little known. On basis of tuberculation and gross ovarian enlargement, appears to spawn in late spring and early summer. Black peritoneum and elongate intestine suggest that diet includes detritus, periphyton, and perhaps macroalgae, contrasting with carnivorous diets of most *Notropis* species.

Compiler: F. F. Snelson, Jr. September 1978.

Notropis niveus (Cope)
Whitefin shiner

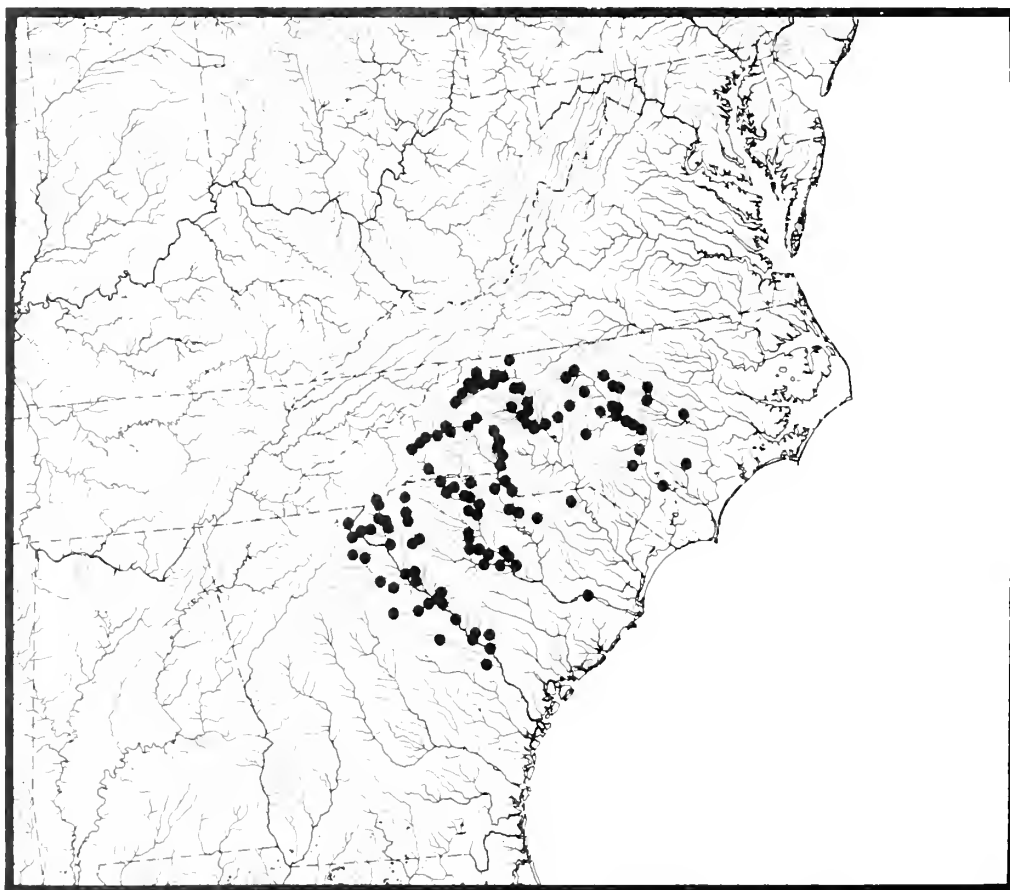
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Upper waters of Catawba River (Santee River drainage), NC (Cope 1870. Proc. Am. Philos. Soc. 11:448-95).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1955. Ph.D. diss., Cornell Univ.) reviewed species and subsequently (Gibbs 1957. Copeia: 185-95) discussed relationships. Gibbs (1955) recognized two subspecies, one (undescribed) from Savannah River drainage and the typical form to the north. Apparently most closely related to *N. callisema*, *N. callitaenia*, and *N. leedsii*.



GA: Taliaferro Co., South
Fork of Little River, 62 mm
SL (NCSM).



DISTRIBUTION AND HABITAT: Savannah to Neuse river drainages, GA, SC, and NC. Gibbs (1955) listed and mapped one specimen from Tar River drainage, NC (Cornell Univ. No. 25884), but Jenkins et al. (1972. Va. Polytech. Inst. State Univ. Res. Div. Monogr. 4: 43-117) and Menhinick (in press. *The Freshwater Fishes of North Carolina*) did not include it from there. In Piedmont and Montane streams of moderate to large size, where it appears to live in lower part of water column, usually in and around riffles. Bottom usually sand and gravel. Usually common.

ADULT SIZE: ca. 67 mm SL maximum.

BIOLOGY: Nothing published.

Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Notropis nubilus (Forbes)
Ozark minnow

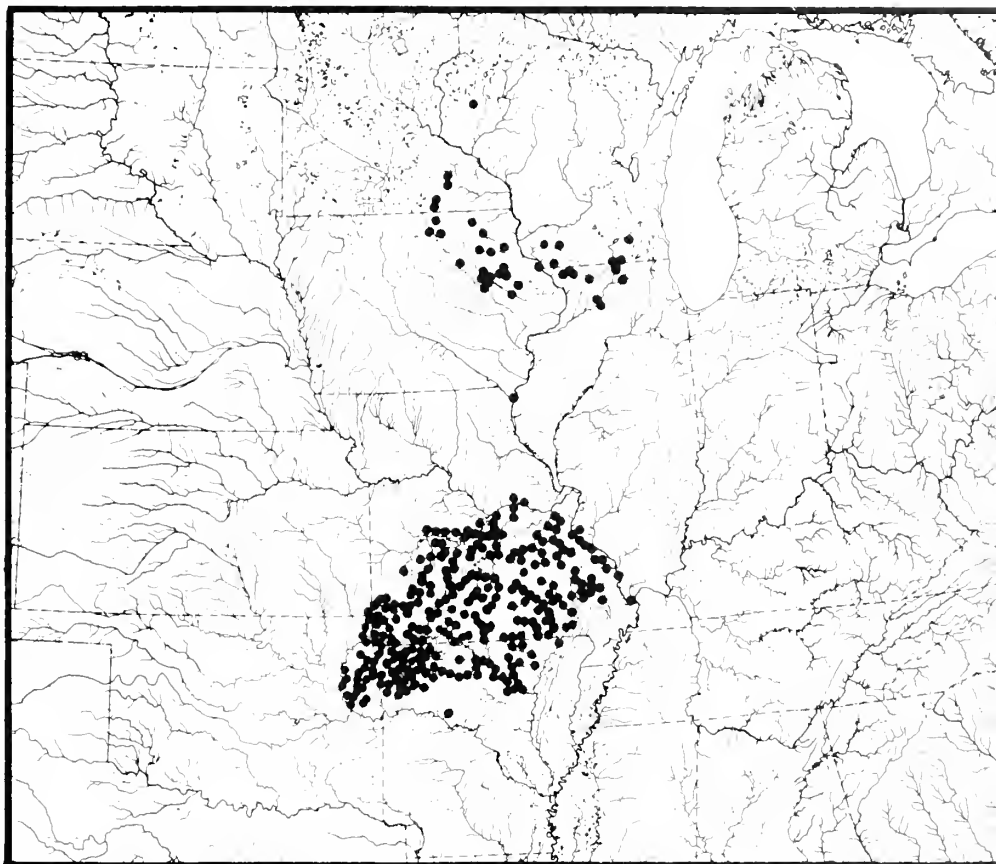
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rock River, at Oregon, Ogle Co., IL (Forbes in Jordan 1878. Bull. Ill. State Lab. Nat. Hist. 2:37-70).

SYSTEMATICS: Subgenus *Hydrophlox*. Long assigned to genus *Dionda*, which differs most notably from *Notropis* in having long gut and herbivorous diet. Swift (1970. Ph.D. diss., Florida State Univ.) placed it in *Notropis* (subgenus *Hydrophlox*), and believed its closest relatives to be *N. leuciodus* and *N. chrosomus*.



MO: Taney Co., White River,
52 mm SL (Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: Formerly more-or-less continuous from north-eastern OK, southeastern KS, and northern AR north to southeastern MN and southern WS, but now disjunct and absent from most of IA, IL, and northern MO. Reported from northwestern WS (Hay River, Barron Co.) by Greene (1935. *The Distribution of Wisconsin Fishes*), but specimens cannot be located (Eddy and Underhill 1976. *Northern Fishes*). Record from intervening section of main Mississippi River presumably based on waif from farther north (Forbes and Richardson 1920. *The Fishes of Illinois*). Typically in clear, medium-sized upland streams with permanent, strong flow and gravel or rocky substrate. Most often found in protected backwaters near riffles, or in pools immediately below riffles where current slackens. Present disjunct distri-

bution results from ecological modification (partly natural, partly man-induced) of areas now predominantly agricultural. Often common to abundant in southern parts of range, much less so to north.

ADULT SIZE: ca. 65 mm TL maximum.

BIOLOGY: Food probably consists of algae, ooze, and surface slime on pebbles in stream bed (Smith 1979. *The Fishes of Illinois*). Often schools near bottom. Spawns in MO from late April to early July, reaching peak in May and June. Commonly spawns over nests of *Nocomis biguttatus*, often in association with *Notropis zonatus*, with which it frequently hybridizes (Pflieger 1975. *The Fishes of Missouri*).

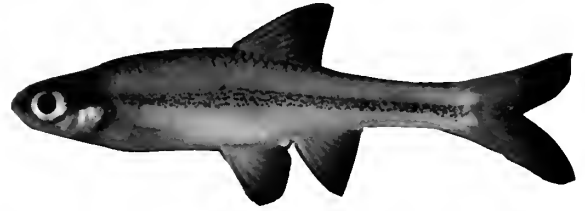
Compilers: C. R. Gilbert and G. H. Burgess.
August 1979.

Notropis ortenburgeri Hubbs
Kiamichi shiner

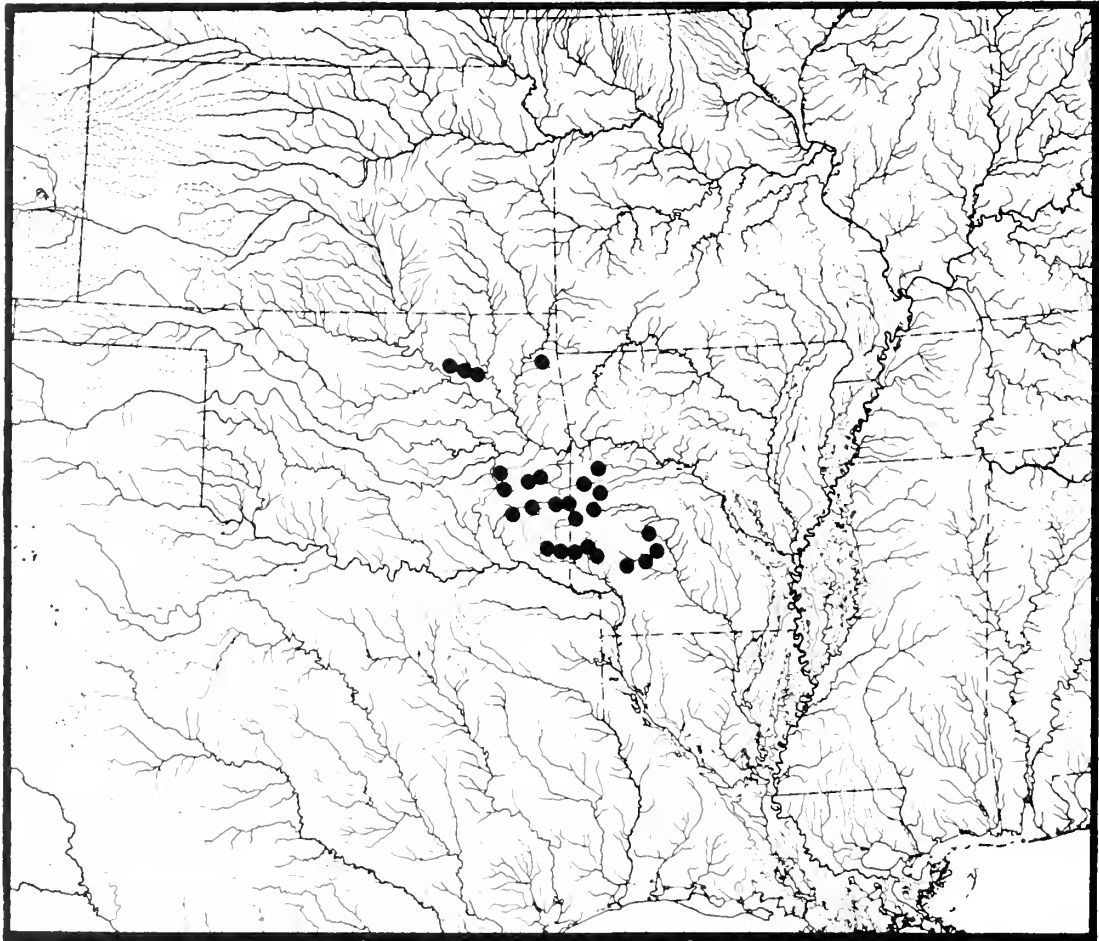
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Mt. Fork River, 16 km se of Broken Bow, McCurtain Co., OK (Hubbs in Ortenburger and Hubbs 1927. Proc. Okla. Acad. Sci. [1926] 6:123-41).

SYSTEMATICS: Subgenus not defined; no systematic review published. Closest relative likely an undescribed species of restricted range in western FL. Relationship to other species more obscure, although Hubbs and Raney (1951. Occas. Pap. Mus. Zool. Univ. Mich. 535:1-25) suggested possible relationship to *N. cummingsae*.



AR: Scott Co., Mill Creek,
44 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upland streams draining Ouachita Mountains of west central and southwestern AR and eastern OK, including portions of Arkansas and Ouachita drainages and Kiamichi and Little river systems of Red drainage. Generally found in small to moderate-sized clear, upland streams of moderate gradient in pools over gravel or boulder substrates.

ADULT SIZE: ca. 46 mm SL maximum.

BIOLOGY: Nothing published.

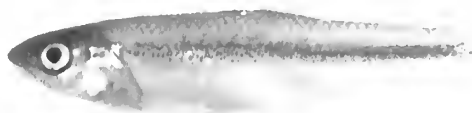
Compiler: H. W. Robison. June 1979.

Notropis oxyrhynchus Hubbs and
Bonham
Sharpnose shiner

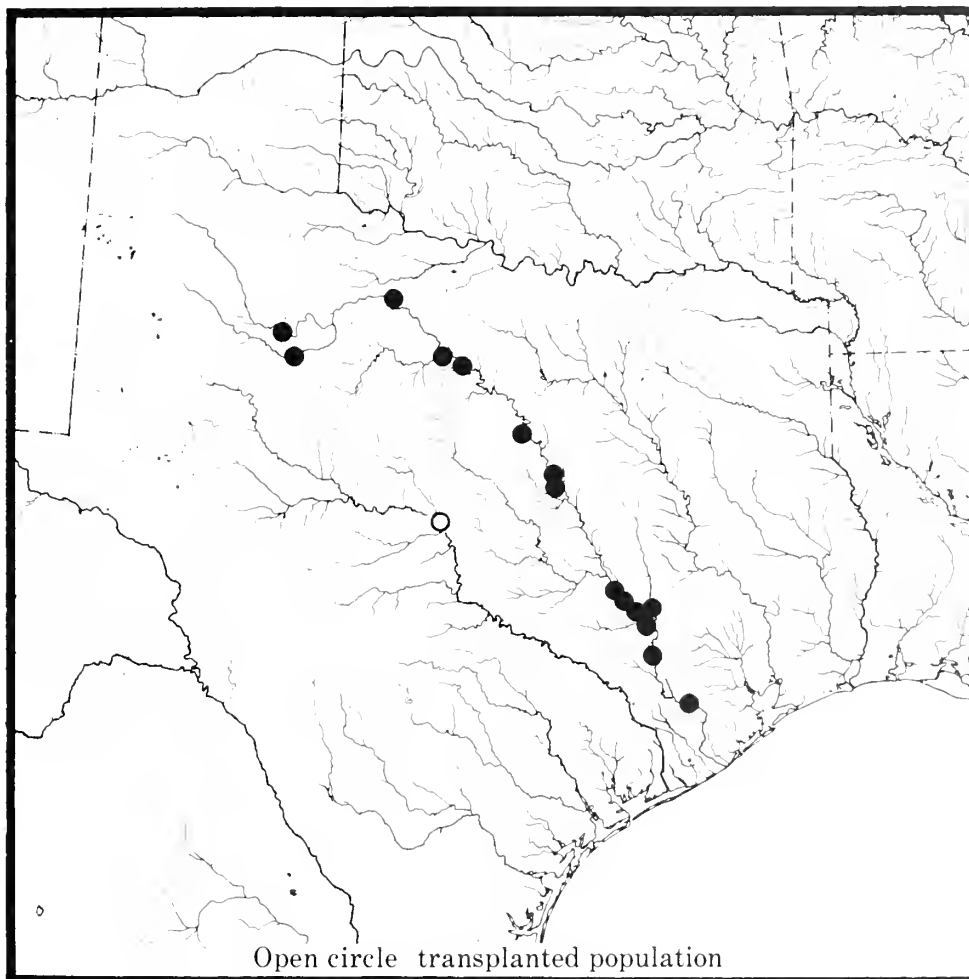
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Brazos River, at Well-born Crossing, Brazos Co., TX (Hubbs and Bonham 1951. Tex. J. Sci. 3:91-110).

SYSTEMATICS: Subgenus *Notropis*. Hubbs and Bonham (1951) indicated closest relative to be *N. atherinoides* (called by them *N. percobromus*), which occurs in Red River drainage to the north and in adjacent drainages to the east. Also related to *N. jemezanus* of Rio Grande drainage, but based principally on zoogeographic considerations, relationships to that species probably less intimate. Systematics of subgenus *Notropis* in general, and species centering around *N. atherinoides* and *N. oxyrhynchus* in particular, in need of study.



TX: Brazos-Burleson Co.,
Brazos River, 48 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Endemic to Brazos River drainage, TX, where appears to be generally distributed throughout main river. Apparently introduced into adjacent Colorado River drainage. Brazos River typically a rather large turbid river, with bottom a combination of sand, gravel and clay-mud. Seems to be fairly common.

ADULT SIZE: ca. 30-50 mm SL.

BIOLOGY: Not studied. Probably similar in many respects to that of *N. atherinoides*.

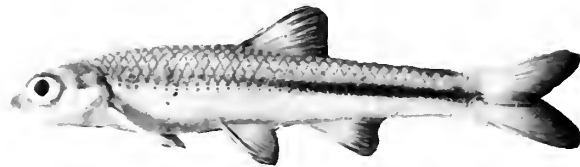
Compiler: C. R. Gilbert. October 1978.

Notropis ozarcanus Meek
Ozark shiner

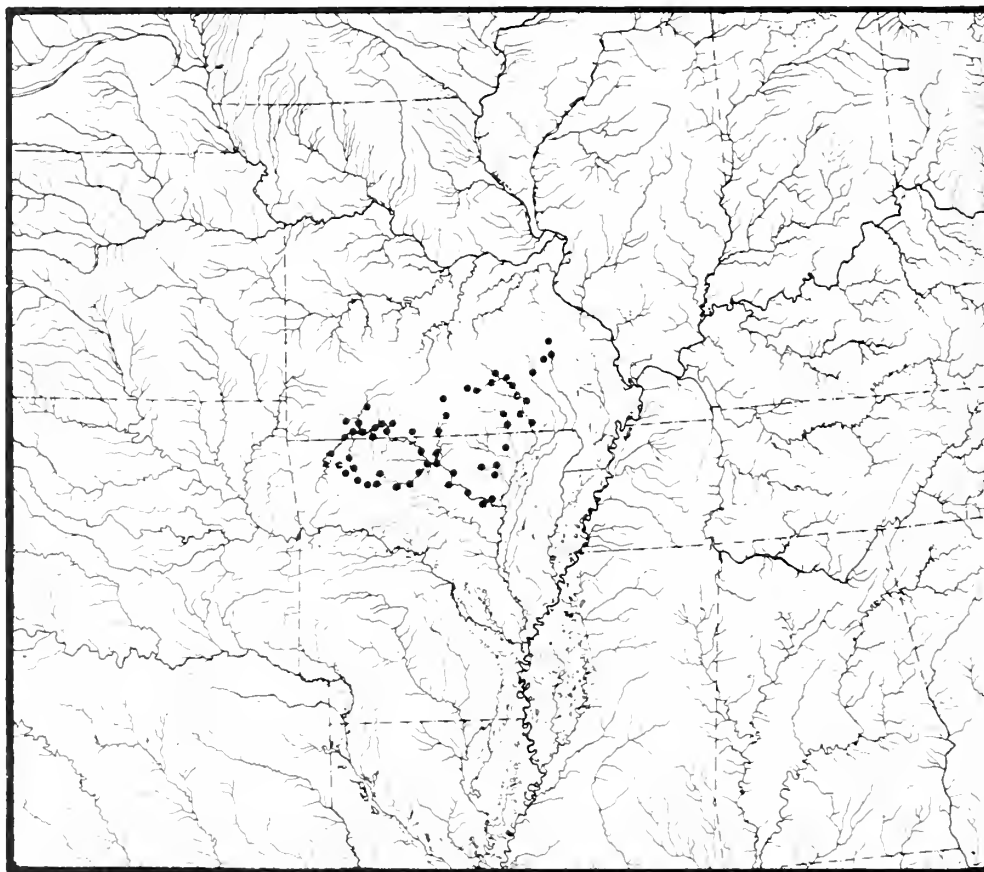
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: North Fork of White River, s of Cabool, Baxter Co., AR (Meek 1891. Bull. U.S. Fish Comm. [1889] 9:113-41).

SYSTEMATICS: No definitive systematic study published. Most closely related to *N. spectrunculus* of upper Tennessee River drainage.



AR: Searcy Co., Buffalo River,
37 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Ozark Uplands of southern MO and northern AR, with most localities in White and Black river systems (White River drainage). Formerly known from headwaters of St. Francis River in southeastern MO, but apparently not collected there recently. Inhabits medium to large, clear streams with high gradient and permanent, strong flow. Most common near riffles in slight to moderate current over firm, silt-free bottom. Formerly common, but now eliminated from many impounded areas.

ADULT SIZE: ca. 45-70 mm TL.

BIOLOGY: Schools in midwater. Adults in spawning condition collected in MO from late May to early August (Pflieger 1975. *The Fishes of Missouri*).

Compilers: C. R. Gilbert and G. H. Burgess.
August 1979.

Notropis perpallidus Hubbs and
Black
Peppered shiner

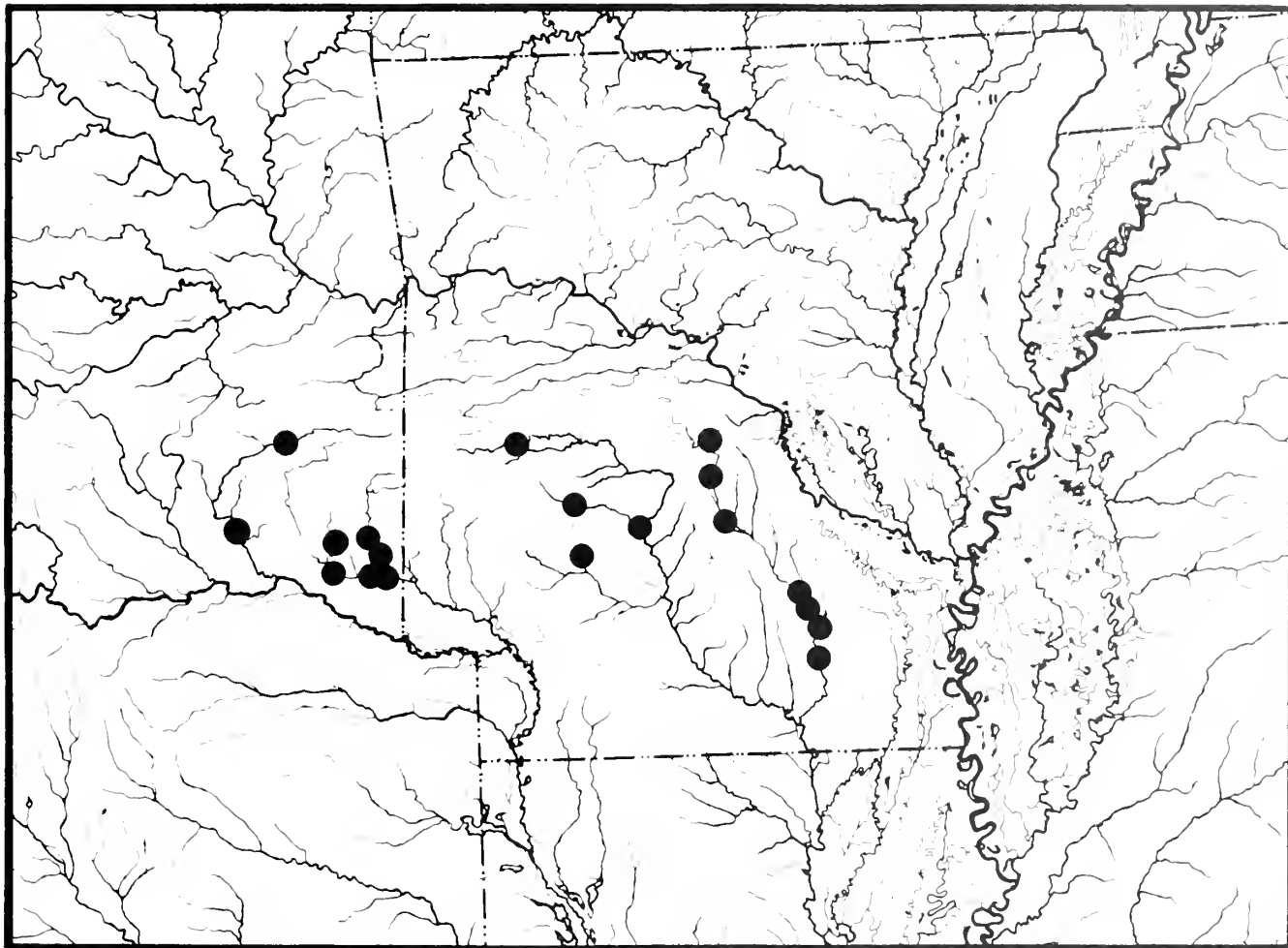
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Saline River, 8.1 km n of Warren, Bradley Co., AR (Hubbs and Black 1940, Copeia:46-49).

SYSTEMATICS: Systematic position not entirely clear, but believed to be a divergent species of the subgenus *Notropis* (Gilbert and Bailey 1962, Copeia:807-19). Snelson and Jenkins (1973, Southwest. Nat. 18:291-304) studied systematics of species and suggested adoption of name peppered shiner.



AR: Montgomery Co., Ouachita River, 32 mm SL male (Snelson and Jenkins 1973).



Map modified from Snelson and Jenkins 1973

DISTRIBUTION AND HABITAT: Restricted to tributaries of Red and Ouachita rivers in southeastern OK and southern AR. In Red drainage is known from Little and Kiamichi rivers, and in Ouachita drainage occurs in Saline, Ouachita, Caddo, and Little Missouri rivers. Inhabits moderate-sized, warm, clear rivers having a gravel substrate. Typically occurs in lees of islands and other obstructions out of main current. Never very common, largest single series consisted of only 21 specimens (Snelson and Jenkins 1973).

ADULT SIZE: 31-41 mm SL.

BIOLOGY: Snelson and Jenkins (1973) discussed growth rates, spawning period, and food items.

Compilers: F. F. Snelson, Jr., C. R. Gilbert, and S. P. Platania. April 1978.

Notropis petersoni Fowler
Coastal shiner

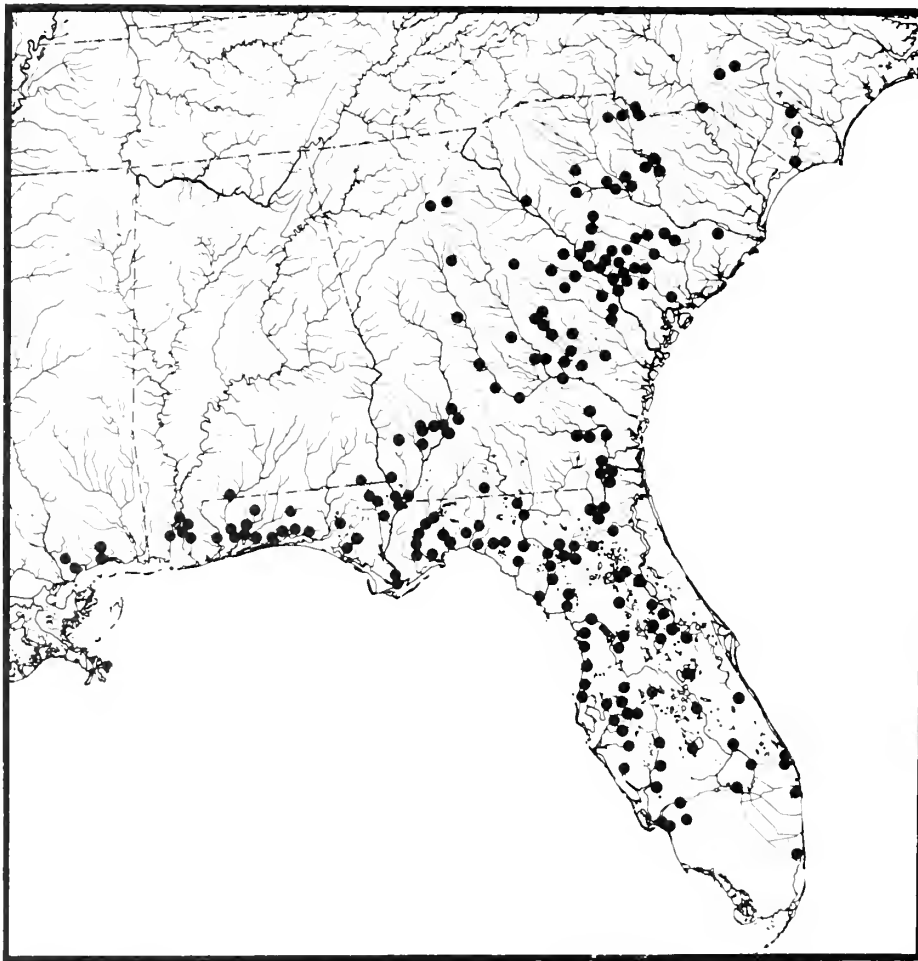
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Crane Creek, below U.S. hwy 1 bridge, Moore Co., NC (Fowler 1942. Not. Nat. 107:1-11).

SYSTEMATICS: Swift (1970. Ph.D. diss., Florida State Univ.) studied systematics. Member of *N. texanus* species group; *N. waccamawensis* and *N. williamsi* are synonyms. Florida peninsular populations with lower counts (Swift 1970; Gilbert 1978. Bull. Fla. State Mus. 23:1-104).



SC: Barnwell Co., Savannah River drainage, male, 52 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Cape Fear and Waccamaw river drainages, NC, south to Lake Okeechobee, Miami area, and Lee Co., FL, and west to Jordan River, MS. No records from Pascagoula River drainage. Inhabits small to large streams and lakes with sandy substrate in Atlantic slope and peninsular FL drainages; more restricted to backwaters, lakes, and coastal areas in west FL, AL, and MS. Usually on or near bottom in flowing water; often in midwater as well in lakes and spring rivers (Swift 1970). Extremely common throughout most of range.

ADULT SIZE: 40-65 mm SL, females average larger.

BIOLOGY: Breeds during March and April in north FL, March to September in south FL, and May and June in NC. Life cycle one year in south FL and three years in NC. Diet predominantly diatoms in spring rivers, insects and crustaceans in other waters (Davis and Louder 1971. Trans. Am. Fish. Soc. 100:726-33; Cowell and Resico 1975. Fla. Sci. 38:113-21; Swift et al. 1977. Bull. Tall Timbers Res. Sta. 20:1-111).

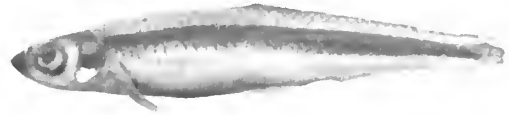
Compiler: C. C. Swift. January 1979.

Notropis photogenis (Cope)
Silver shiner

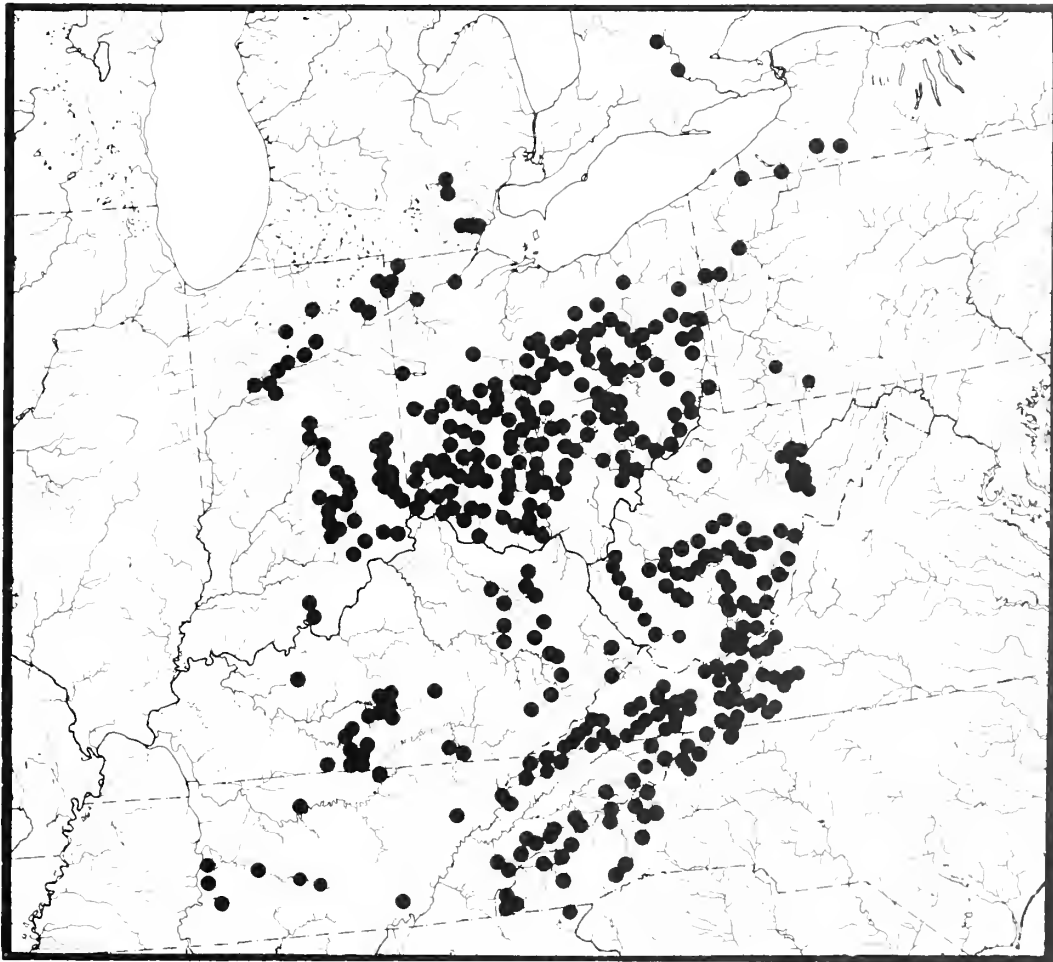
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Youghiogheny River, PA (Cope 1865. Proc. Acad. Nat. Sci. Phila. [1864] 16:276-85).

SYSTEMATICS: No comprehensive systematic study has been published. Snelson (1968. Copeia:776-802) considered it to belong to subgenus *Notropis*, and thus closely related to those species centering around *N. atherinoides*. Gilbert (1971. Copeia:474-79) discussed problems associated with type specimens.



NC: Ashe Co., Roan Creek, 111 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Throughout much of Ohio River basin except for western lowlands, south to Tennessee River drainage. Occupies western Lake Erie tributaries and Grand River system, a northeastern Lake Erie tributary in ON. Typically in medium to large, clear, weedless streams of moderate to high gradient, usually with a gravel to boulder substrate. Occurs in varying abundance, often common in many parts of Ohio basin; generally uncommon to rare in Lake Erie tributaries.

ADULT SIZE: ca. 64-114 mm SL.

BIOLOGY: No comprehensive life history or ecological study exists, and no good summary of miscellaneous information appears to have been published. Gruchy et al. (1973. J. Fish. Res. Board Can. 30:1379-82) provided data on food (primarily insect larvae) from several individuals from ON.

Compiler: C. R. Gilbert. July 1978.

Notropis pilsbryi Fowler
Duskystripe shiner

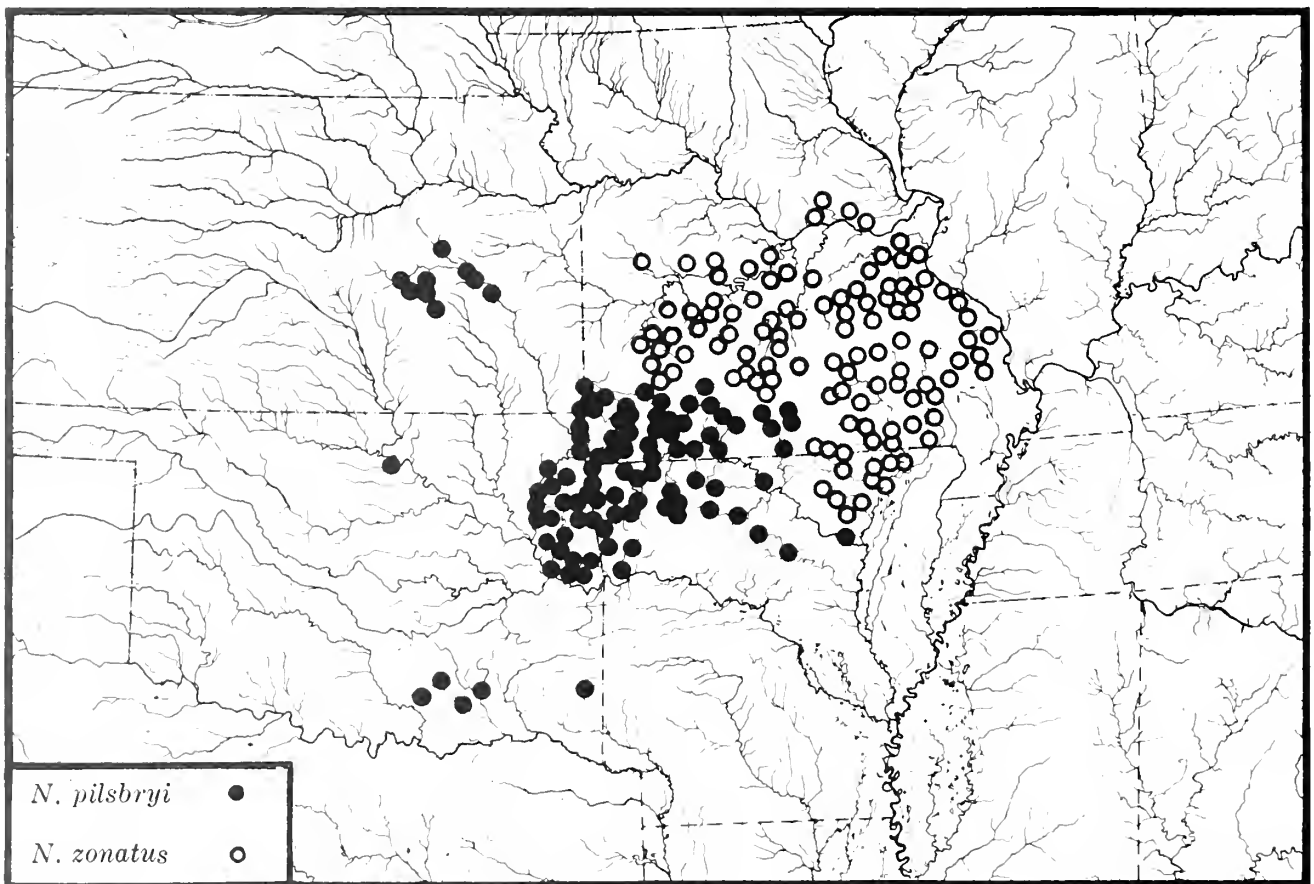
Order Cypriniformes
Family Cyprinidae



AR: Independence Co., Polk Bayou, 66 mm SL (NCSM).

TYPE LOCALITY: White River system, at Rogers, Benton Co., AR (Fowler 1904. Proc. Acad. Nat. Sci. Phila. 56: 242-49).

SYSTEMATICS: Subgenus *Lurilus*, Gilbert (1964. Bull. Fla. State Mus. Biol. Sci. 8: 95-194) reviewed systematics and separated it specifically from closely related *N. zonatus*, of which it had formerly been regarded a subspecies. Menzel and Cross (1977. Abstr. 57th Ann. ASIH meetings) recommended recognition of *N. zonatus* and *N. pilsbryi* as subspecies based on biochemical similarities, but Buth (in press. Biochem. Syst. Ecol.), who also studied biochemical properties, favored continued recognition as full species.



DISTRIBUTION AND HABITAT: White River system (excluding Black River system) of AR and MO, and a few tributaries of Arkansas and Red rivers in AR, KS, and OK. Typically in small to medium-sized streams with gravel-rubble substrate and clear, rapidly-flowing water. Often most common fish present, particularly in White River drainage and in Neosho River system of OK.

ADULT SIZE: ca. 85 mm SL maximum.

BIOLOGY: Moore and Paden (1950. Am. Midl. Nat. 44:76-95) published observations on spawning behavior in OK. Pflieger (1975. *The Fishes of Missouri*) described aspects of biology as being essentially identical to those of *N. zonatus*. See account of that species for details.

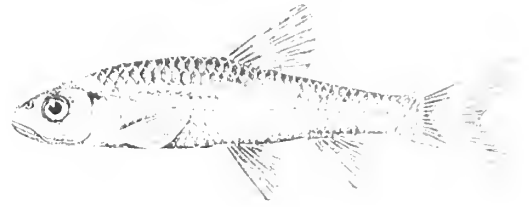
Compiler: C. R. Gilbert. April 1979.

***Notropis potteri* Hubbs and Bonham**
Chub shiner

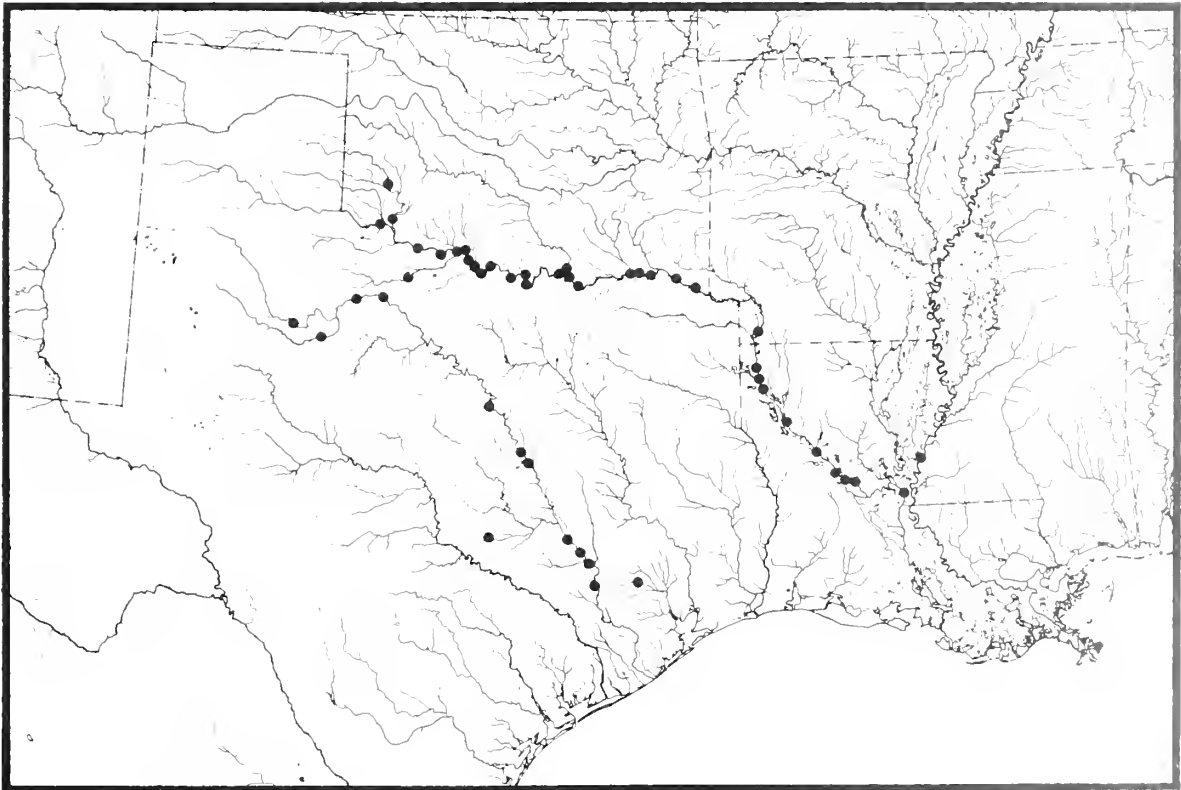
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Waco Creek, near Waco, McLennan Co., TX (Hubbs and Bonham 1951. Tex. J. Sci. 3:91-110).

SYSTEMATICS: Adults are very similar in appearance to *N. blennius*; thus the two species have been considered intimately related. On basis of certain dissimilarities in morphology (particularly of young individuals) and behavior, however, Suttkus and Clemmer (1968. Tulane Stud. Zool. Bot. 15:18-39) suggested this may be result of convergent evolution. They also presented meristic and morphometric data and compared *N. potteri* with *N. blennius* and *N. edwarddraneyi*.



(NCSM)



DISTRIBUTION AND HABITAT: Essentially restricted to Brazos River drainage of TX and Red River drainage of TX, OK, AR, and LA. Enters limited area of Mississippi River in LA, and occurs in lower parts of Colorado River and Galveston Bay (San Jacinto and Trinity rivers) drainages in TX, where presumed to be native (Conner 1977. Ph.D. diss., Tulane Univ). Common in large, usually turbid, flowing streams with bottom consisting primarily of sand and gravel, often overlain with silt.

ADULT SIZE: ca. 35-55 mm SL, Red River drainage. Largest individuals 86 mm SL (Brazos River), 65 mm SL (Red River).

BIOLOGY: Suttkus and Clemmer (1968) noted consistent rigid lateral projection of pectoral fins, in contrast to *N. blennius* and *N. edwarddraneyi*. Their hypothesis that this was an adaptation for living close to bottom has been supported by many field observations. *Notropis blennius* lives higher in water column.

Compiler: C. R. Gilbert. October 1978.

Notropis procne (Cope)
Swallowtail shiner

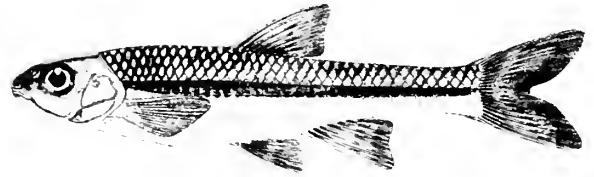
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Conestoga River, tributary of Susquehanna River, PA (Cope 1865. Proc. Acad. Nat. Sci. Phila. 16:276-85). Lectotype designated by Fowler (1909. Proc. Acad. Nat. Sci. Phila. [1908] 60:517-53), but see Gilbert (1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104).

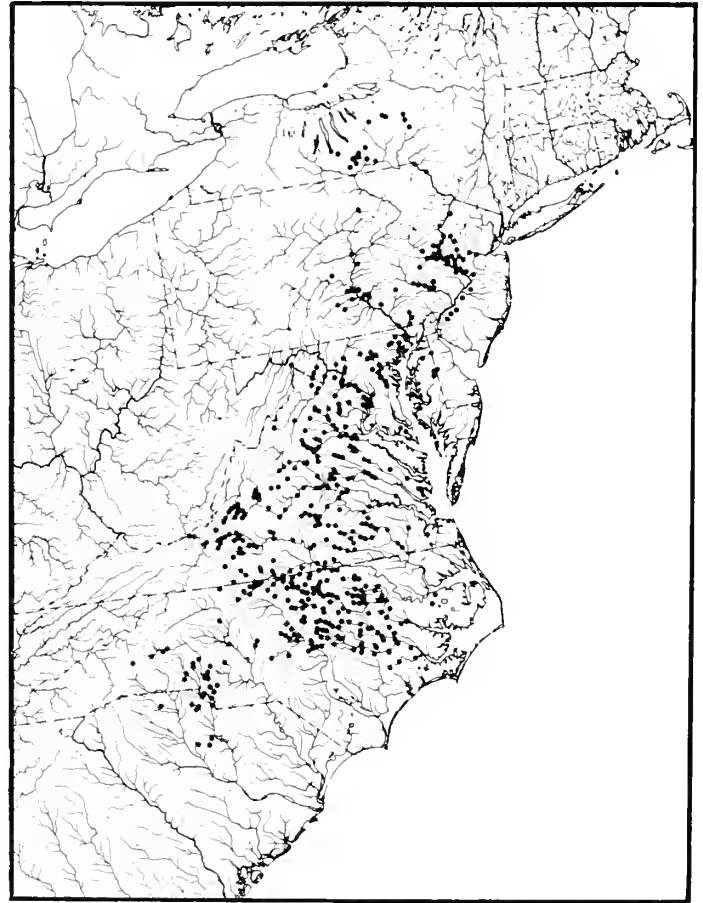
SYSTEMATICS: Subgenus uncertain; formerly in *Alburnops*. Probably closely related to *N. alborus*, *N. mekistocholas*, and *N. stramineus* (Hubbs and Raney 1947. Occas. Pap. Mus. Zool. Univ. Mich. 498: 1-17; Snelson 1971. Copeia:449-62). Apparent closest relative is undescribed paleband shiner, now restricted to Little South Fork Cumberland River, KY, and extirpated from lower Clinch River system, TN. Southern subspecies, *N. procne longiceps*, diagnosed by Raney (1947), of dubious status (Snelson 1971).

DISTRIBUTION AND HABITAT: Atlantic slope, above and below Fall Line, from Santee drainage, SC, north to Susquehanna and Delaware drainages, NY. Apparently localized in Pee Dee drainage, NC. Nominal southern form extends north into Roanoke drainage, VA. Nominate form occupies James drainage north; also known from Lake Ontario drainage, NY: one record from Catherine Creek, a Seneca Lake tributary, in 1927 (Greeley 1928. N.Y. State Cons. Dept., Suppl. 17th Annu. Rep.:84-107); one record from Lake Ontario at Fair Haven State Park, Cayuga Co. in 1951 (E. C. Raney, Cornell Univ. 34592). Recently discovered in New River drainage, VA, between Claytor Lake and WV line. Inhabits warm, moderate to low gradient, clear to often turbid, small streams to large rivers. Usually occupies pools and slow runs with sand, gravel, or rock bottom. Often common.

ADULT SIZE: 30-60 mm SL.



MD: Baltimore Co.—Harford Co., Little Gunpowder River, 51 mm SL (NCSM).

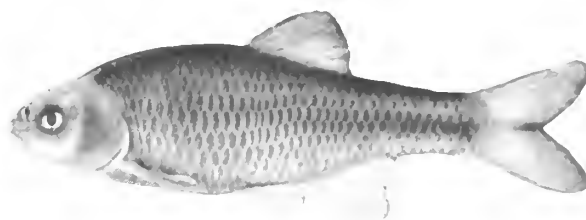


BIOLOGY: Food largely aquatic insects and, particularly, algae (Breder and Crawford 1922. Zoologica 2:287-327). Spawns late spring and early summer. Lives two to three years, with some specimens maturing at one year (Raney 1947).

Compilers: R. E. Jenkins and D. S. Sorensen.
June 1979.

Notropis proserpinus (Girard)
Proserpine shiner

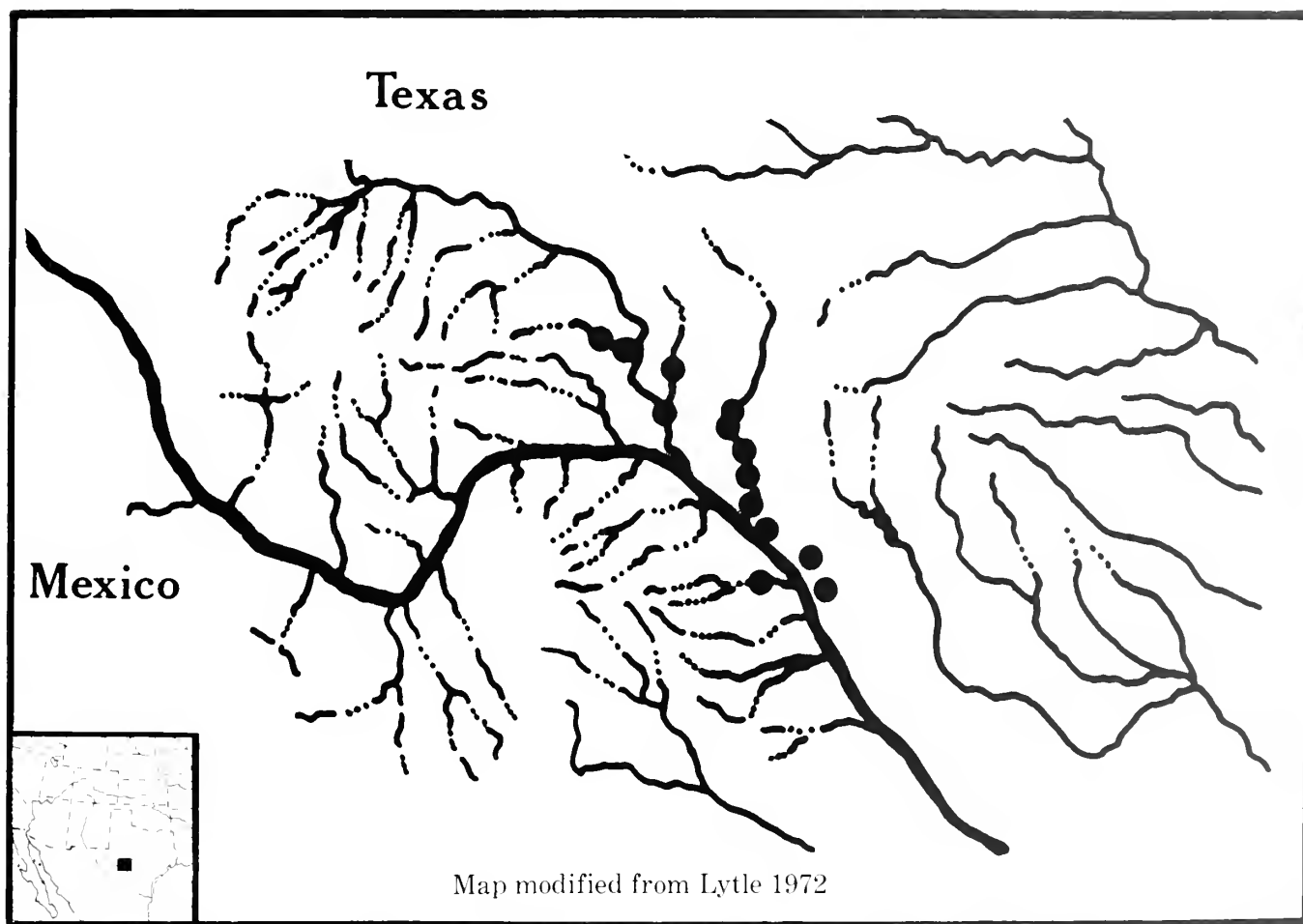
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: Devil's River, TX, probably just above mouth in Val Verde Co., (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Subgenus *Cyprinella*. Key characters and photographs are in Hubbs (1954. Tex. J. Sci. 6:277-91), synonymies and taximetric analysis in Lytle (1972. M.S. thesis, Arizona State Univ.). Complete analysis by Hubbs and Miller (1978. Copeia: 582-592).

TX: Val Verde Co., Johnsons Fork of Devils River, 56 mm SL (J.L. Harris).



DISTRIBUTION AND HABITAT: Pecos and Devil's rivers, TX; Las Moras, Pinto, and San Felipe creeks (west TX); and Rio San Carlo, Mexico. Not in mainstream Rio Grande. In clear streams occupies habitats varying from pools to swift channels and riffles. Second most abundant minnow in Devil's River (Harrell 1978. Copeia:60-68).

BIOLOGY: Little known. Harrell (1978) reported feeding near bottom, and quick or abundant reproduction after severe flooding. Harrell attributed success of species in harsh environments to ecological plasticity (i.e., shifting of habitat after environmental perturbation).

ADULT SIZE: 25-60 mm SL.

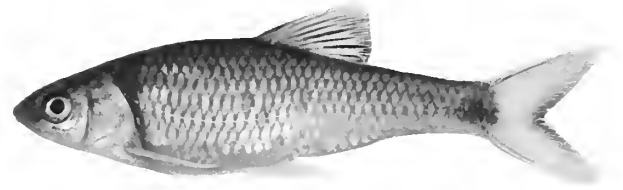
Compiler: W. J. Matthews. June 1979.

Notropis pyrrhomelas (Cope)
Fieryblack shiner

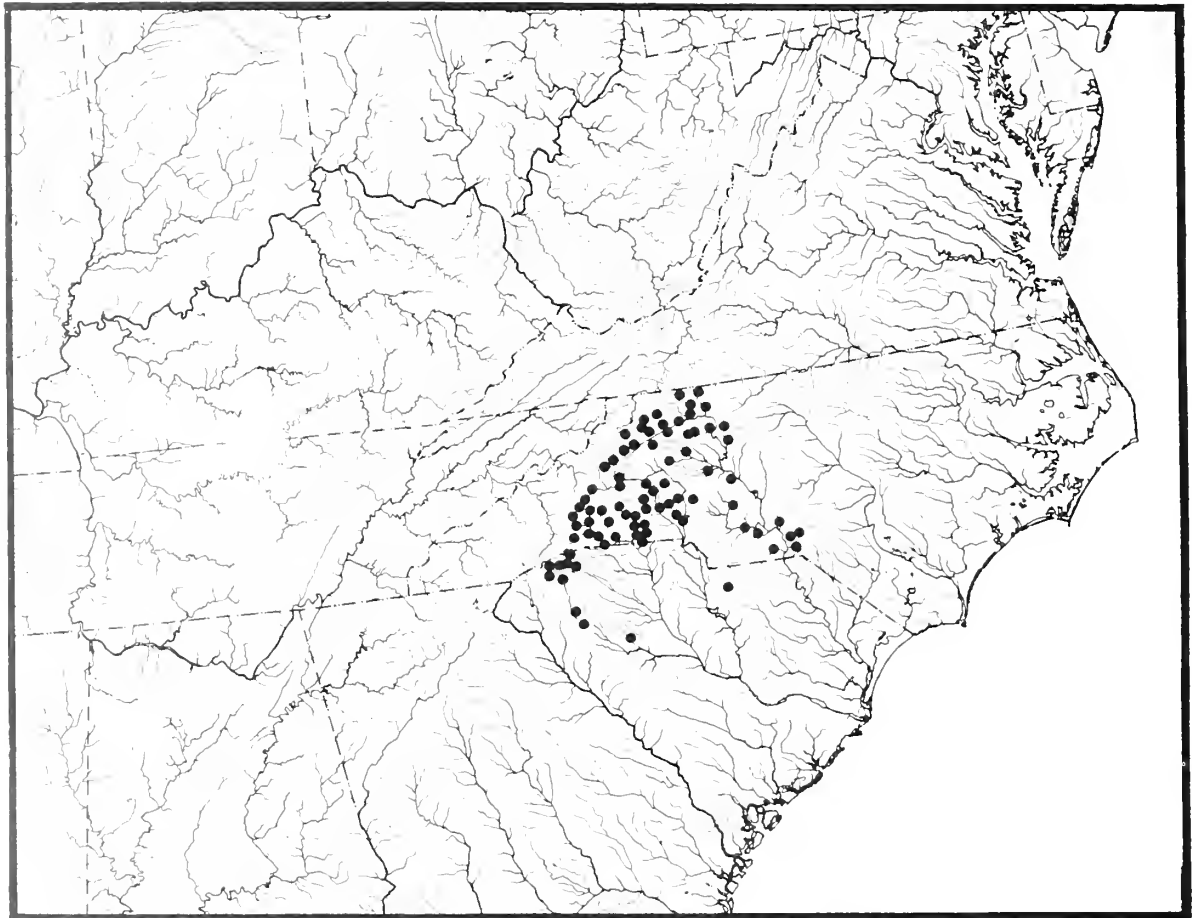
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributary of upper Cat-
awba River, NC. (Cope 1870. Proc. Am. Phi-
los. Soc. 11:448-95).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs
(1955. Ph.D. diss., Cornell Univ.) studied
systematics of subgenus and determined
(Gibbs 1957. Copeia 3:185-95) closest pro-
bable relative to be *N. xanurus*. Gibbs also
found considerable morphological different-
iation between populations from Santee and
Peedee river drainages, tentatively regarded
as distinct subspecies.



SC: Greenville Co., South
Tyger River, 70 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Piedmont
and montane areas of Santee and Peedee
river drainages, SC and NC. Usually in mod-
erate-sized streams, where often concentra-
ted in pools below riffles or behind large
obstructions. Sometimes among large rocks
in riffles. Usually common in preferred hab-
itat.

ADULT SIZE: Not reported. Maximum size
ca. 70 mm SL.

BIOLOGY: Not studied.

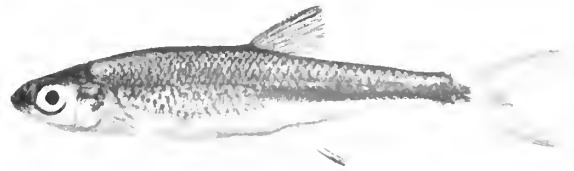
Compiler: C. R. Gilbert. December 1978.

Notropis roseipinnis Hay
Cherryfin shiner

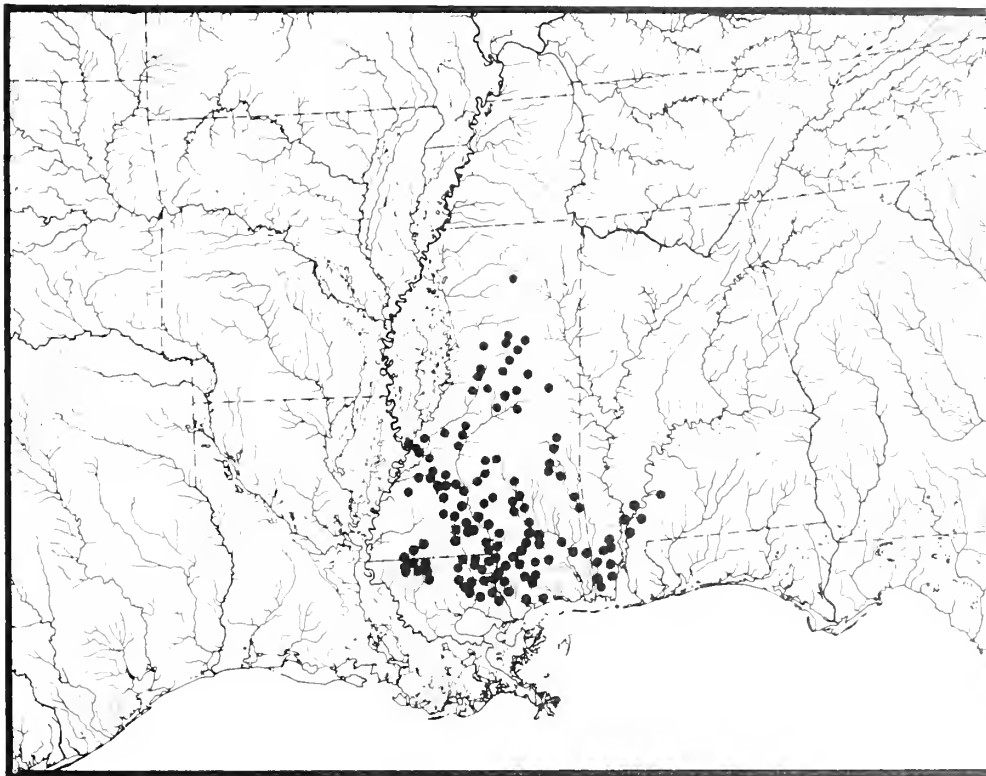
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Chickasawha River and tributaries near Enterprise, Pascagoula River drainage, Clarke Co., MS (Hay in Jordan 1885. Ann. Rept. Comm. Fish Fisheries [1884]: 787-973).

SYSTEMATICS: Subgenus *Lythrurus*, most closely related to *N. b. bellus* and *N. atripiculus*. Marked east-west clinal variation in several character complexes. No subspecies recognized. Snelson (1972. Bull. Fla. State Mus. Biol. Sci. 17:1-92) reviewed systematics of this and closely related species.



MS: Forrest Co., 4.8 km s of Johnston State Park, male, 45 mm SL (F. F. Snelson).



Map from Snelson 1972

DISTRIBUTION AND HABITAT: Gulf slope drainages from Mobile Bay west through Lake Pontchartrain. In Mississippi Valley, in Bayou Pierre, Big Black, and Yazoo drainages of western MS. One report from Coles Creek, Jefferson Co., MS. Primarily in small Coastal Plain streams with sand or sand-gravel bottoms. Inhabited streams usually have moderate gradient, providing riffle or run-pool habitats. Common.

ADULT SIZE: 30-50 mm SL.

BIOLOGY: Spawns late March through August or early September, with peak activity early and late in reproductive season. Number of ova per female 58-293, positively correlated with female size. Eggs average 0.77 mm diameter. Rarely lives more than one year (Heins and Bresnick 1975. Trans. Am. Fish. Soc. 104:516-23).

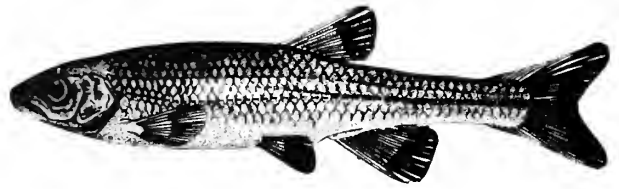
Compiler: F. F. Snelson, Jr. September 1978.

Notropis rubellus (Agassiz)
Rosyface shiner

Order Cypriniformes
Family Cyprinidae

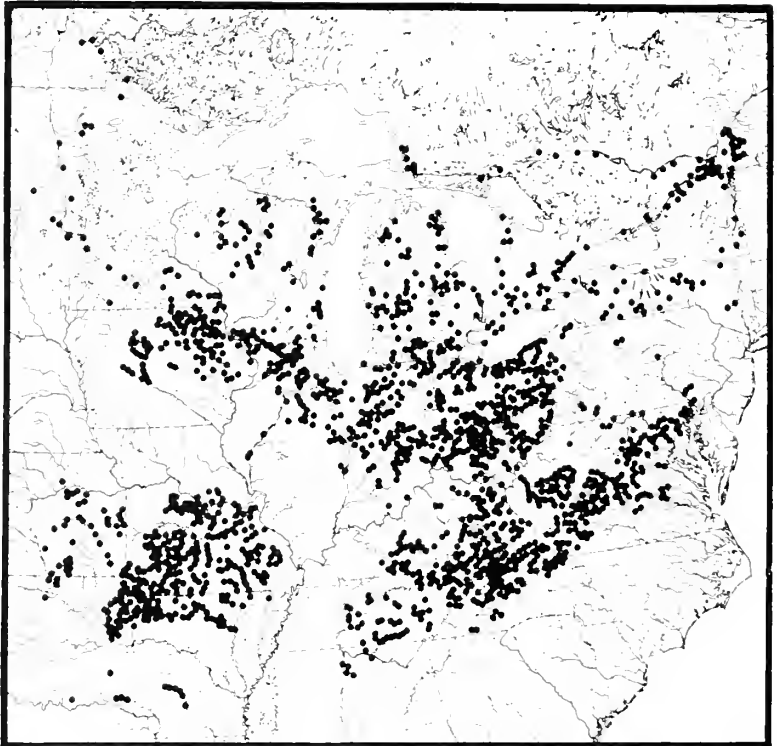
TYPE LOCALITY: Lake Superior, at Sault Ste. Marie, either MI or ON (Agassiz 1850. *Lake Superior*).

SYSTEMATICS: Subgenus *Hydrophlox*. Only member of *N. rubellus* species group (Swift 1971. Diss. Abstr. 31B: 3081). Formerly considered member of subgenus *Notropis*, until shown by Snelson (1968. Copeia: 776-802) to differ trenchantly from members of that group. Compared by Snelson (1968) with *N. amoenus* and *N. atherinoides*. Species name *percobromus*, long considered to apply to *N. atherinoides* or a closely related species, shown by Gilbert (1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104) to be based on Ozarkian population of *N. rubellus*; name is available should that population prove specifically or subspecifically distinct.



MD: Carroll Co., Patapsco River, 54 mm SL (NCSM).

DISTRIBUTION AND HABITAT: Red River of North drainage, MB and MN, east throughout most of Great Lakes basin (except northern and western tributaries of Lake Superior) to St. Lawrence River drainage, QU, ON, NY, and VT. South on Atlantic slope from Hudson River, NY, to James River drainage, VA (excluding Delaware drainage). West of Appalachians, in upper Ohio and Mississippi river basins from PA to ND, MN, and IA, and (east of Mississippi River) south to Tennessee River drainage of NC, TN, and AL. West of Mississippi River in Ozarkian uplands of northern AR, eastern OK, and eastern KS to southern tributaries of lower Missouri River in MO. Isolated population in upper Ouachita River system, AR. Typically in clear, fast-flowing large creeks and small rivers with bottoms of clean gravel or rubble; usually in or around riffles. Generally common to abundant.



ADULT SIZE: 75 mm SL maximum.

BIOLOGY: Several biological studies published, including Adams and Hankinson (1928. Roosevelt Wild Life Ann. 1:235-548), Pfeiffer (1955. Copeia:95-103), and Miller (1964. Am. Midl. Nat. 72:313-57) in NY, and Reed (1957. Copeia: 286-90; 1958. Copeia: 325-57) in PA. Raney (1940. Copeia: 270-1) studied hybridization with *N. cornutus* in NY. Spawns from June (in MI) to July

(in IA) in upper parts of riffles, upstream from or over nesting *N. cornutus*, *Nocomis biguttatus*, or *Nocomis micropogon*. Hybridizes commonly with *N. cornutus* and *N. chrysocephalus*, and reported to do so with some other species. Young tend to omnivory; adults eat mostly insects (both aquatic and terrestrial). Commonly lives three years.

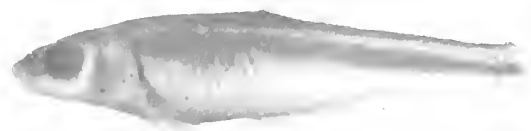
Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

***Notropis rubricroceus* (Cope)**
Saffron shiner

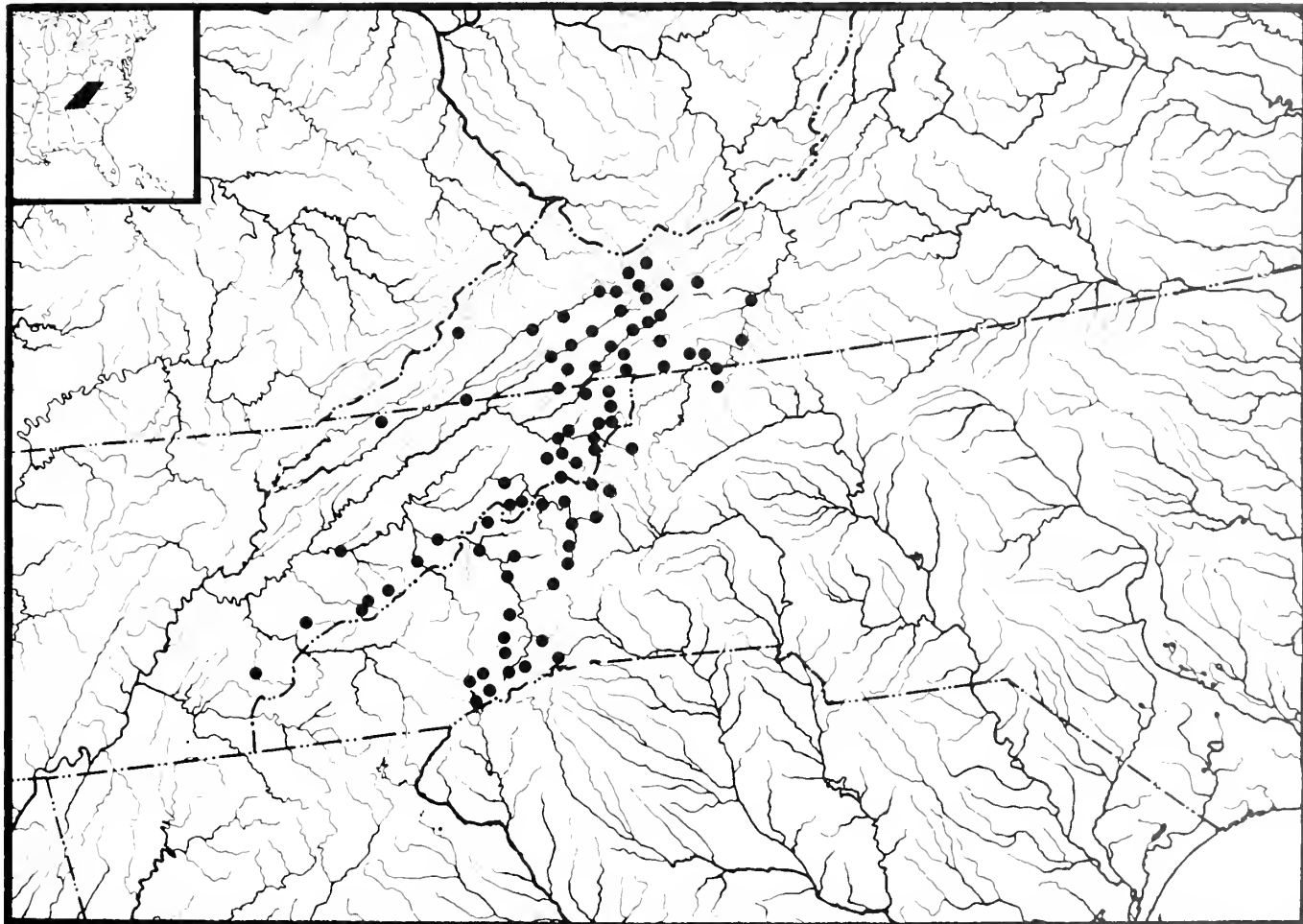
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Near mouth of Tumbling Creek, tributary to North Fork of Holston River, VA (Cope 1868. J. Acad. Nat. Sci. Phila. 6:207-47).

SYSTEMATICS: Subgenus *Hydrophlox*. No detailed systematic study of species has been published. Swift (1970. Ph.D. diss., Florida State Univ.) reviewed relationships and considered closest relatives to be *N. chiliticus*, *N. chlorocephalus*, *N. lutipinnis*, and *N. baileyi*.



NC: Alleghany Co., Elk Creek,
69 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upper Tennessee River drainage in eastern TN, NC, and VA; headwaters of Savannah and Santee river drainages, NC (probably native). Recently recorded from headwaters of New River drainage, NC, where presumably introduced (Ramsey 1965. Ph.D. diss., Tulane Univ.). Inhabits small, clear, cool, high gradient headwater streams with gravel-rubble bottom; restricted to upland and montane situations probably more than any other species of *Notropis*. Usually common.

ADULT SIZE: 40-60 mm SL, ca. 70 mm SL maximum.

BIOLOGY: Outten (1958. J. Elisha Mitchell Sci. Soc. 74:122-34) published detailed account of biology. Spawns from May to July, often over nests of *Nocomis micropogon*, at temperatures of at least 18.9°C. Most do not survive beyond three years, but a few may live four or even five years. Feeds mostly on aquatic insect larvae, primarily ephemeropterans and dipterans.

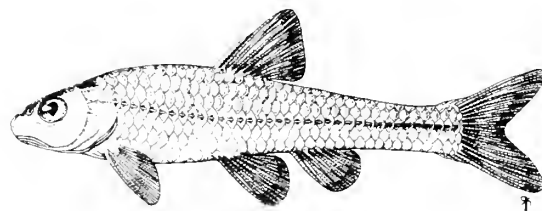
Compiler: C. R. Gilbert. August 1978.

Notropis sabiniae Jordan and
Gilbert
Sabine shiner

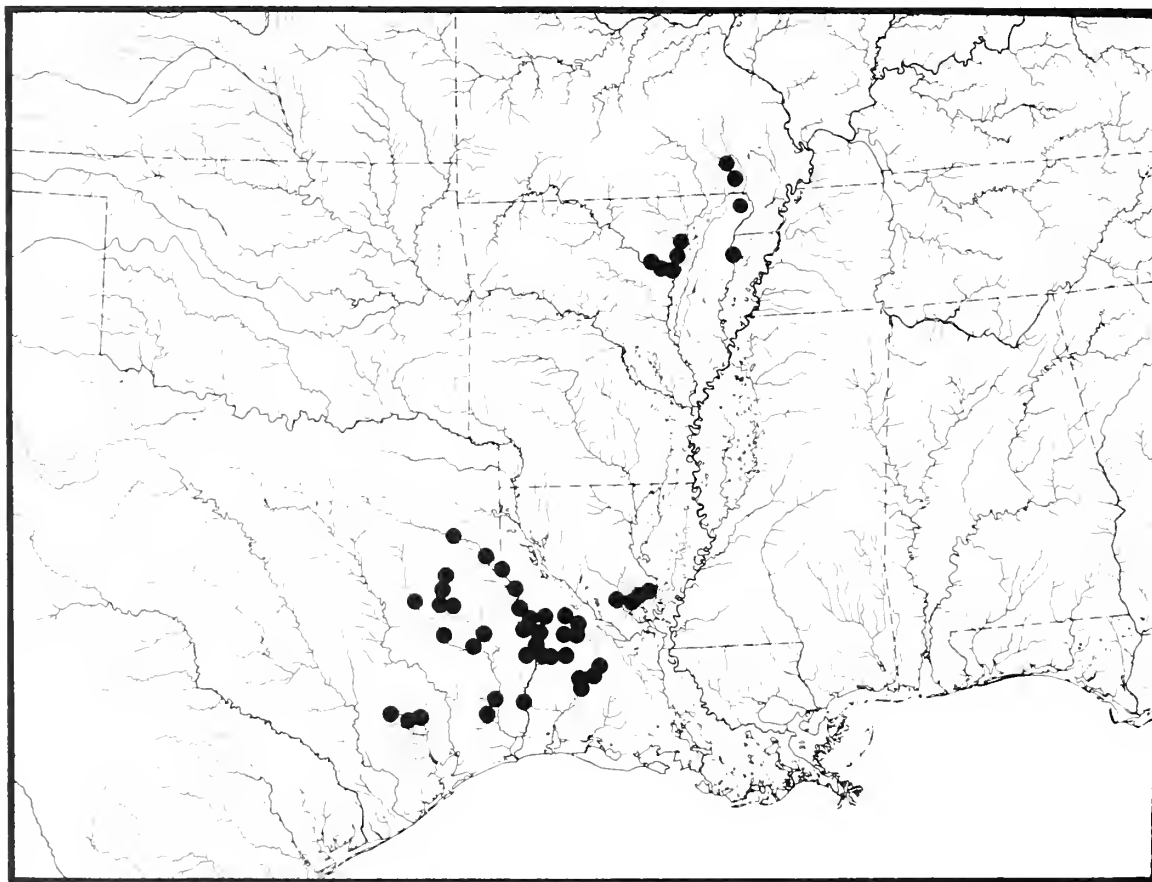
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Sabine River, 8 km s of Longview, Gregg Co., TX (Jordan and Gilbert 1886. Proc. U. S. Natl. Mus. 9:1-25).

SYSTEMATICS: Forms closely related complex of species along with *N. longirostris* and one (possibly two) undescribed species occurring in Mobile Bay basin and independent eastern tributaries of Mississippi River. Suttus is studying systematics of group.



(NCSM)



DISTRIBUTION AND HABITAT: Curious and unique disjunct distribution. Along Gulf coast from San Jacinto River drainage, TX, east to Calcasieu River and small section of lower Red River drainage in LA. Semi-disjunct population in lower Mississippi River drainage of eastern LA; widely disjunct population in White and Black river systems of northeastern AR and southeastern MO and St. Francis River of extreme northeastern AR. Closely restricted to substrate of fine, silt-free sand in smaller streams and rivers having slight to moderate current. Common in some areas, rare elsewhere.

ADULT SIZE: Not determined. Largest specimen 57 mm TL.

BIOLOGY: Not studied. Probably similar in most respects to that of closely related *N. longirostris*, reported by Heins and Clemmer (1975. Am. Midl. Nat. 94:284-95; 1976. J. Fish Biol. 8:365-79).

Compiler: C. R. Gilbert. October 1978.

Notropis scabriceps (Cope)
New River shiner

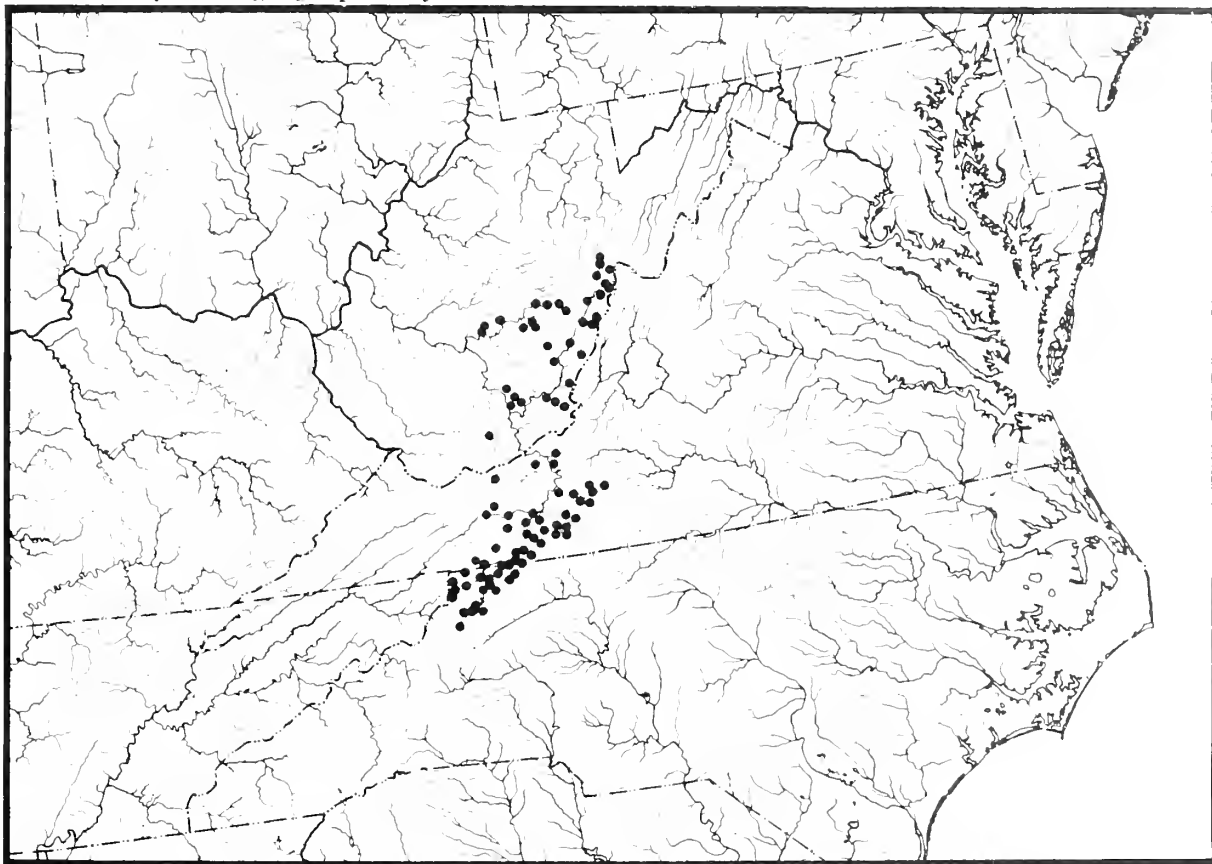
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITIES: Syntypes from tributaries of New River, VA, including unnamed creek near Austinville, Wythe Co., Sinking Creek (probably Giles Co.) and Walkers Creek (probably Giles Co.) (Cope 1868. Proc. Acad. Nat. Sci. Phila. [1867] 19:156-66; also Gilbert 1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104).

SYSTEMATICS: Monotypic species. Subgeneric allocation uncertain. Similar in form and color to a large number of small shiners, including *N. blennius*, *N. stramineus*, and *N. volucellus* (Gilbert 1961. Copeia:450-56) whose subgeneric status also is unresolved. Gilbert (1961) and Jenkins et al. (1972. Va. Polytech. Inst. State Univ. Res. Div. Monog. 4:43-117) stated that *N. scabriceps* may have affinity with geographically close



NC: Ashe Co., North Fork New River, 59 mm SL (NCSM).



N. semperasper, placed in subgenus *Notropis*. Swift (1970. Ph.D. diss., Florida State Univ.) suggested closest relatives are *N. boops* of Mississippi basin and *N. xenocephalus* of Mobile drainage, neither currently placed subgenerically. More recent study by Jenkins indicates that *N. scabriceps* most similar to *N. greeniei*, an Ozarkian endemic of otherwise unclear affinity.

DISTRIBUTION AND HABITAT: Known only from New (upper Kanawha) River drainage, NC, VA, WV. Widespread in drainage, but generally distributed only in

upper section in the Blue Ridge province where often common. Rarely taken in last 20 years from Ridge and Valley province, VA. Sporadic in WV. Typically found in pools and slow runs of small to large size, cool to warm streams, over rocks, gravel, sand and occasionally moderate deposits of silt.

ADULT SIZE: 40-70 mm SL.

BIOLOGY: Largely unknown. Spawns late spring to mid-summer, based on gonadal development.

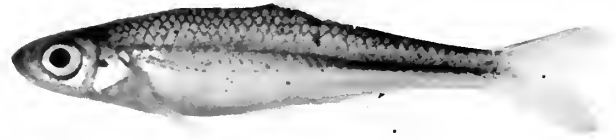
Compiler: R. E. Jenkins. February 1979.

Notropis scepticus (Jordan
and Gilbert)
Sandbar shiner

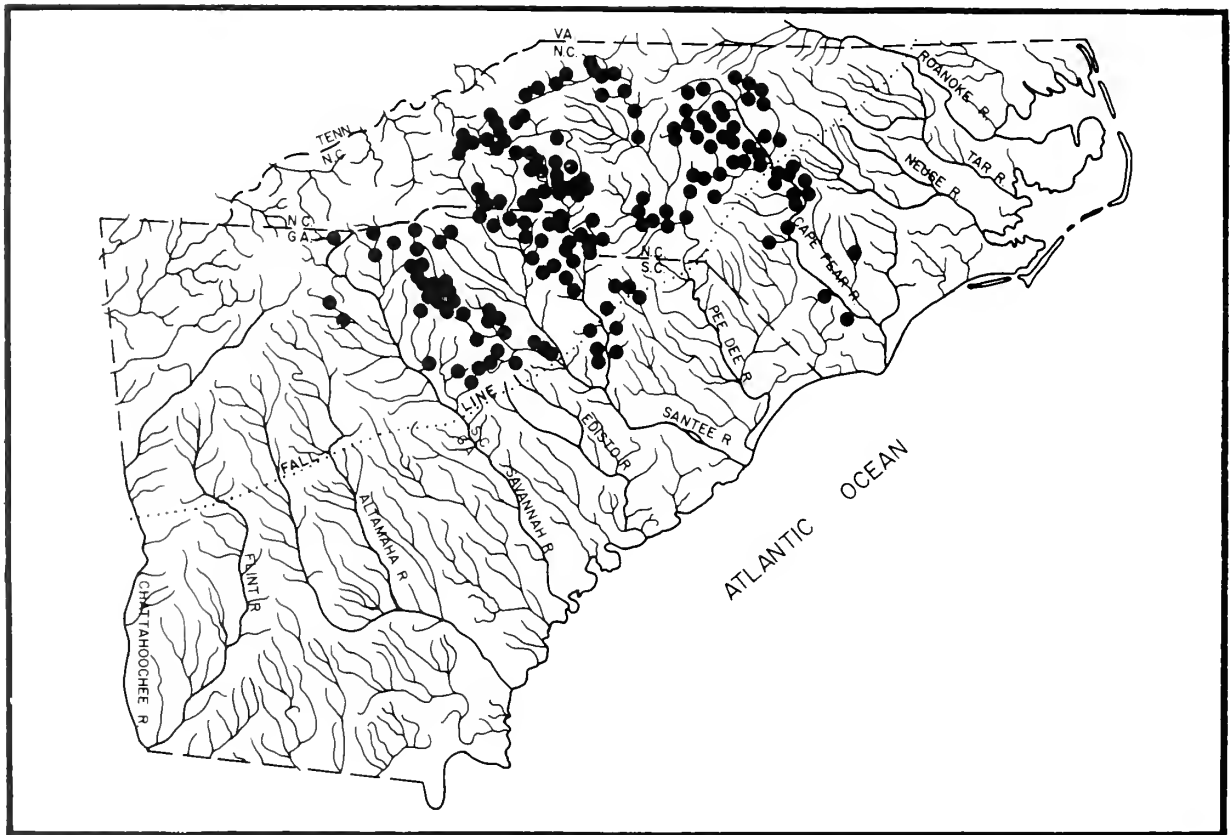
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Saluda River, near Farr's Mill, w of Greenville, Greenville Co., SC (Jordan and Gilbert 1883. U. S. Natl. Mus. Bull. 16:1-1018).

SYSTEMATICS: Subgenus *Notropis* (Snelson 1968. Copeia:776-802).



NC: Randolph Co., Uwharrie River, 66 mm SL (NCSM).



Map from Harrell and Cloutman 1978

DISTRIBUTION AND HABITAT: Primarily in Blue Ridge foothill and Piedmont streams, from Cape Fear drainage, NC, to Savannah drainage, GA (Hubbs 1941. Copeia:165-74; Harrell and Cloutman 1978. Copeia:443-47). Typically inhabits flowing pools over sandy substrate, upstream or downstream from rocky riffles in small to medium-sized, 2-30 m wide, clear streams.

ADULT SIZE: 50-75 mm SL.

BIOLOGY: Harrell and Cloutman (1978) studied age, growth, reproduction, and food habits of population in Kings Creek, SC. Spawns from late May through early July, and food consists mainly of insects.

Compiler: D. G. Cloutman. July 1978.

Notropis semperasper Gilbert
Roughhead shiner

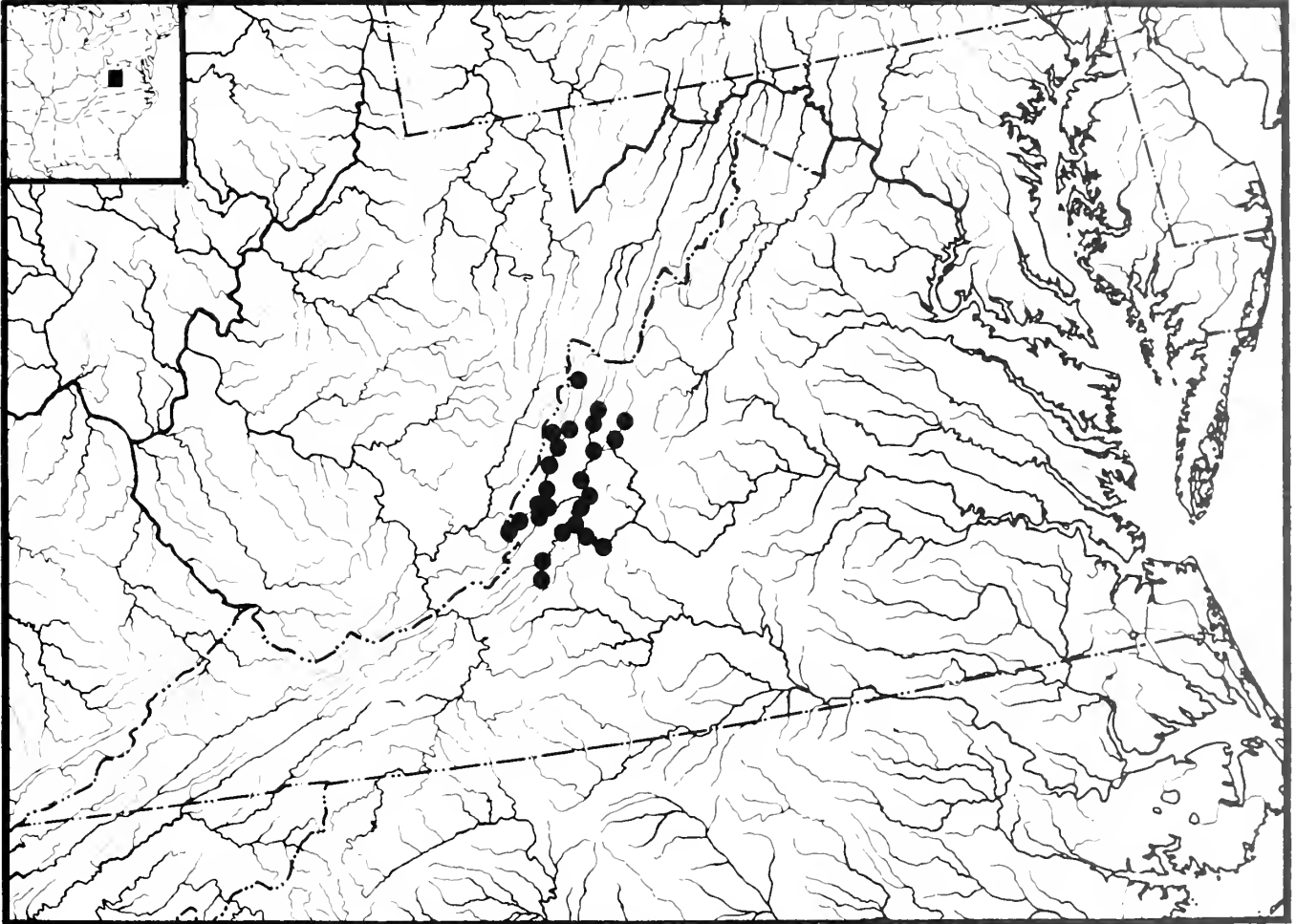
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Potts Creek, just above jet. with Jackson (James) River at state hwy. 18 bridge, near Covington, Alleghany Co., VA (Gilbert 1961. Copeia:450-56).



SYSTEMATICS: Subgenus *Notropis*. Jenkins and Burkhead (1975. Chesapeake Sci. 16:178-91) and Snelson (1968. Copeia:776-802) reviewed systematics and morphology. Apparently unique among *Notropis* in that even young and juveniles possess cephalic "breeding" tubercles.

VA: Jackson River, 60 mm SL
(Jenkins and Burkhead 1975).



Map from Jenkins and Burkhead 1975

DISTRIBUTION AND HABITAT: Endemic to Ridge and Valley province of upper James River drainage, VA. Typically inhabits warm, usually clear, medium to large streams with moderate gradient, hard bottom and little siltation. Prefers slow to moderate currents of pools and backwaters. Relatively common.

BIOLOGY: Jenkins and Burkhead (1975) studied certain life history aspects. Most spawning occurs in May or June, but may extend into August. Most individuals live no longer than three years, but a few may survive into the fourth year.

ADULT SIZE: 45-65 mm SL, 73 mm SL maximum.

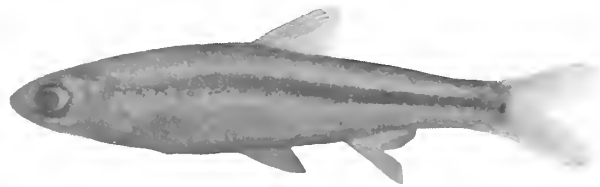
Compiler: C. R. Gilbert. August 1978.

Notropis shumardi (Girard)
Silverband shiner

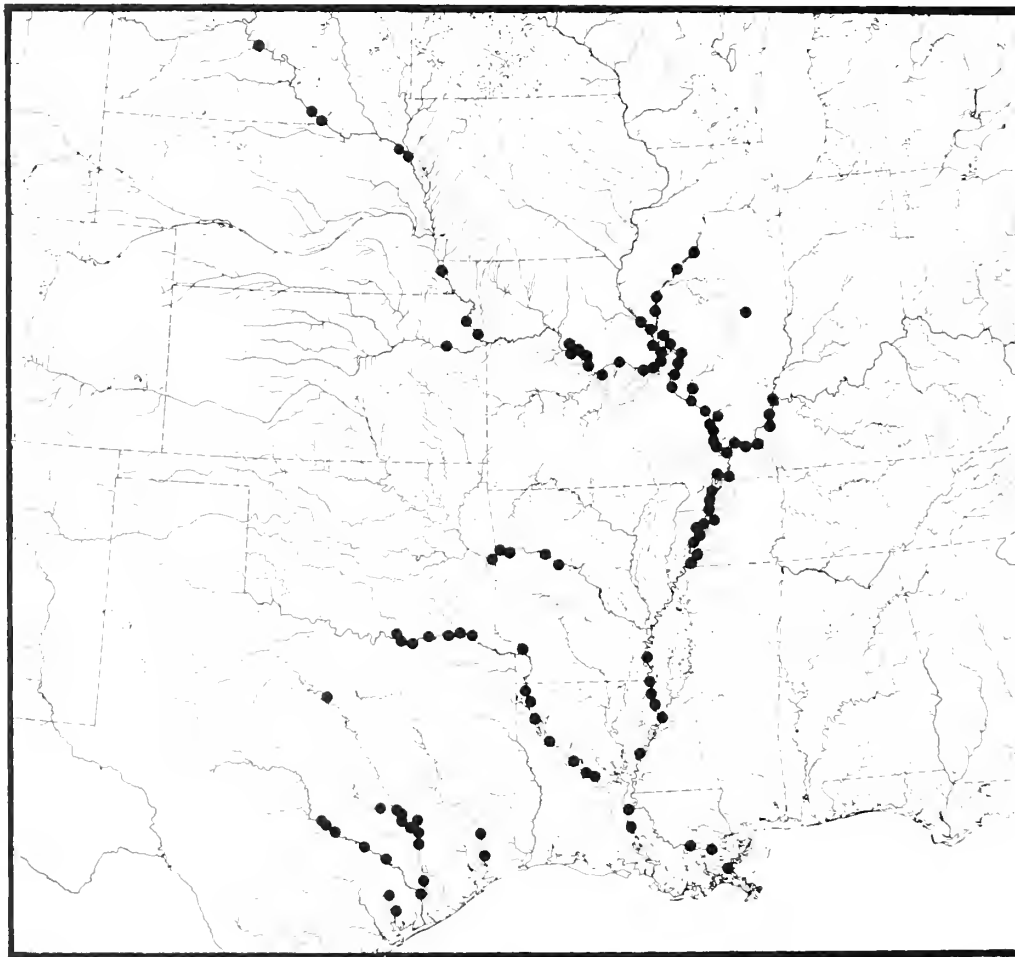
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Arkansas River, near Fort Smith, AR (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Gilbert and Bailey (1962. Copeia: 807-19) studied systematics. Precise relationships uncertain, although characteristics more or less intermediate between subgenera *Notropis* and *Luxilus* noted. They also changed name from *illecebrosus* to *shumardi*, and determined that nominal species *N. brazosensis* (from TX and middle Red River



TX: Brazos Co., Brazos River,
47 mm SL (NCSM).



drainage) was junior synonym, despite having lower average vertebral, anal-ray, lateral-line scale, and predorsal scale counts. Material from lower Red River (unavailable in 1962) will be critical in substantiating that these differences are indeed variational in nature.

DISTRIBUTION AND HABITAT: Confined to Mississippi River and main tributaries, and several isolated drainages on the TX Gulf slope. In Mississippi River ranges from near mouth north to Missouri River in central SD. Absent from upper Mississippi River (except just above mouth of Missouri River), most of Ohio River basin, and other major eastern tributaries. Geographically

disjunct TX population ranges from Lavaca Bay system east to Trinity River. Closely confined to large rivers, where usually common. Such rivers characteristically very turbid and have substrate that is mixture of sand, gravel, silt and mud.

ADULT SIZE: ca. 43-70 mm SL.

BIOLOGY: Little known. Said to spawn in late May in IL (Forbes and Richardson 1920. *The Fishes of Illinois*). Gilbert and Bailey (1962) noted that microscopic size of nuptial tubercles likely indicates non-specialized breeding behavior.

Compiler: C. R. Gilbert. October 1978.

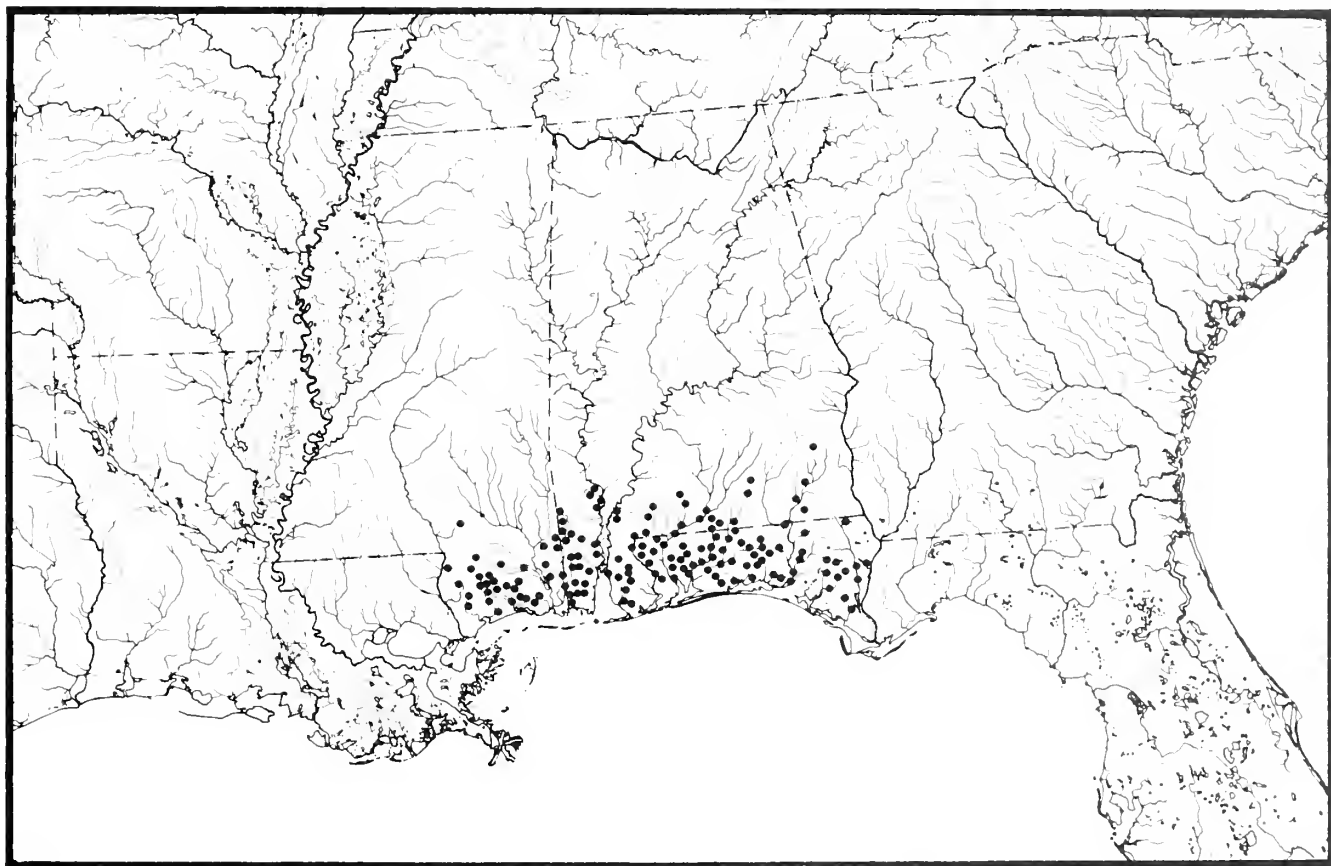
Notropis signipinnis Bailey and
Suttkus
Flagfin shiner

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Maletts Spring Branch tributary to Rocky Creek, tributary to Escatawpa River (Pascagoula River drainage), 10.65 km se of Lucedale, George Co., MS (Bailey and Suttkus 1952. Occas. Pap. Mus. Zool. Univ. Mich. 542:1-15).

SYSTEMATICS: Subgenus *Pteronotropis*. Most closely related to *N. hypselopterus* and *N. euryzonus*.

AL: Baldwin Co., Tensaw River system, 43 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Gulf slope lowlands, from Apalachicola River drainage (principally Chipola River system), FL, west to Pearl River and eastern Lake Pontchartrain drainages, LA and MS. Typically in open, flowing areas of clear, frequently stained waters of tiny to moderate-sized creeks (up to 6 m wide) containing considerable aquatic vegetation, particularly golden club, *Orontium*. Often abundant.

ADULT SIZE: up to 56 mm SL.

BIOLOGY: Nothing published.

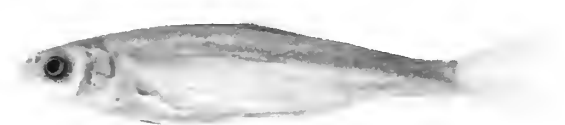
Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

***Notropis simus* (Cope)**
Bluntnose shiner

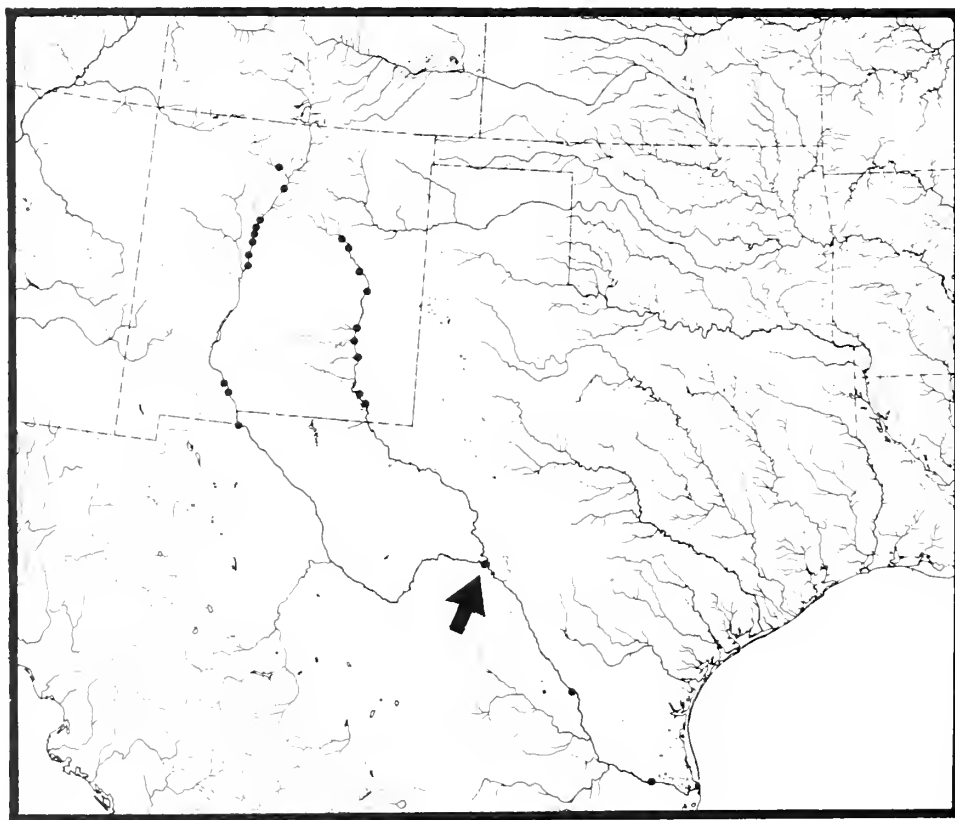
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio Grande, at San Ildefonso, ca. 16 km e of Los Alamos, Santa Fe Co., NM (Cope in Cope and Yarrow 1875. Geol. and Geogr. Explor. & Surv. W of 100th Mer. 5:637-700).

SYSTEMATICS: Precise systematic relationships unknown, although superficially resembles *N. bairdi* and *N. girardi*, particularly when small. Highly variable anal-ray count, overall ranging from 7 to 11, and varying from 7 to 10 or 8 to 11 within a single series. Koster (1957. *Guide to the Fishes of New Mexico*) considered populations from Pecos River drainage to represent an undescribed species, but unpublished data (B. Chernoff, R. R. Miller and compiler) show this not to be the case.



NM: Bernalillo Co., Rio Grande,
Isleta Diversion Dam, 46 mm
SL (NCSM).



DISTRIBUTION AND HABITAT: Rio Grande basin (including Pecos River drainage) of NM, TX, and Mexico, with records throughout length of river (none from major tributaries in Mexico). Formerly common, but now apparently extirpated from Rio Grande proper (last record in 1965), and much reduced in numbers in Pecos River of NM. Typically in main river channels, often below obstructions, over substrate of sand, gravel, and silt. Damming and irrigation practices presumably are factors contributing to decline.

ADULT SIZE: Maximum size at least 65-70 mm SL.

BIOLOGY: Nothing known.

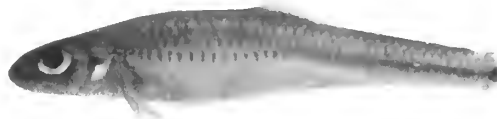
Compiler: C. R. Gilbert. January 1980.

Notropis spectrunculus (Cope)
Mirror shiner

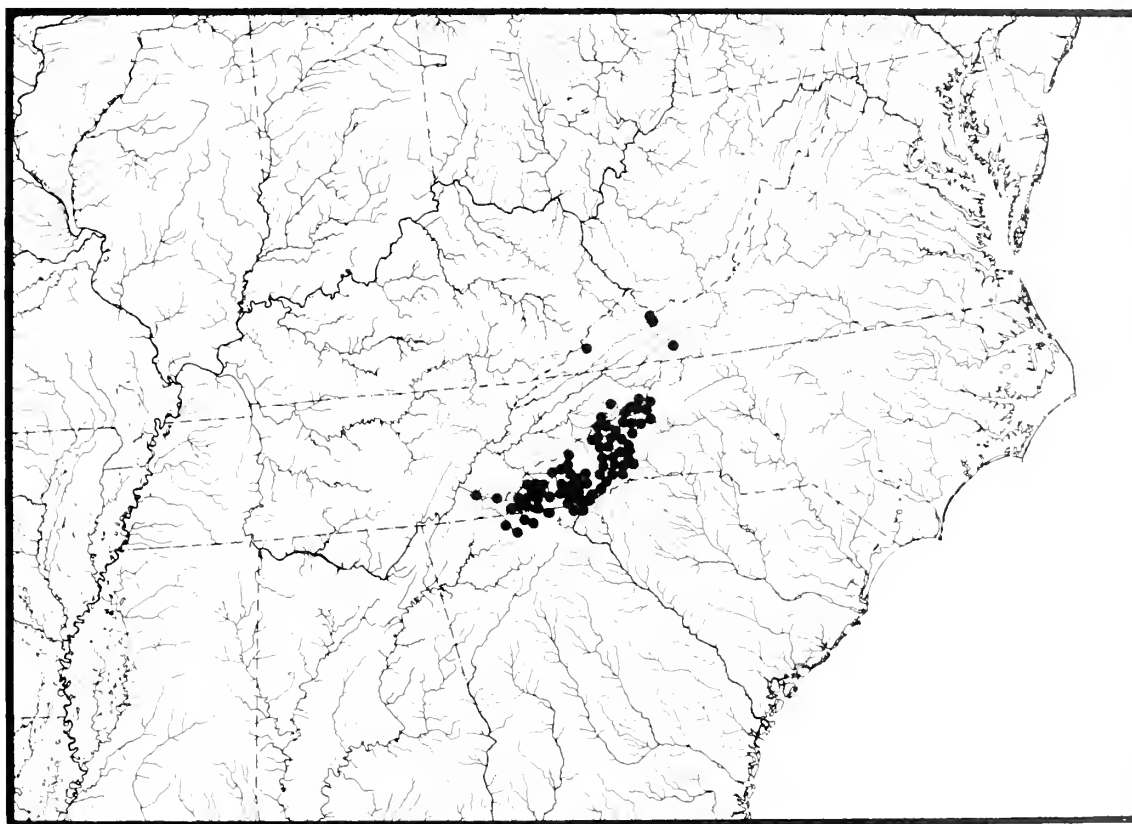
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Bear Creek (tributary to Middle Fork of Holston River), Smyth Co., VA (Cope 1868. J. Acad. Nat. Sci. Phila. [Ser. 2] 6:207-47).

SYSTEMATICS: No definitive study published. Most closely related to *N. ozareanus* of Ozark uplands of southern MO and northern AR. Also apparently closely related to undescribed species in Cumberland and Tennessee river drainages, long considered identical.



GA: Union Co., Nottely River,
65 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upper Tennessee River drainage of GA, TN, NC, and VA. Also in upper Savannah and Catawba-Santee river drainages of NC, which it presumably reached through stream capture. Typically in clear, rubble-bottomed upland streams of small to moderate size. Very common and generally distributed in streams of northern GA, and western NC; much less common and more sporadically distributed in TN and western VA, an apparently natural situation

likely based on abrupt changes in stream gradient of Tennessee River tributaries, particularly as they cross from NC into TN (Gilbert and Seaman 1973. ASB Bull. 20:55).

ADULT SIZE: attains a length of at least 55 mm SL.

BIOLOGY: Nothing published.

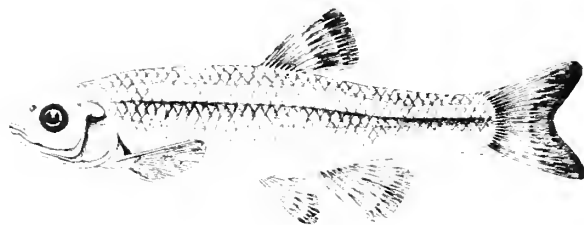
Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

Notropis spilopterus (Cope)
Spotfin shiner

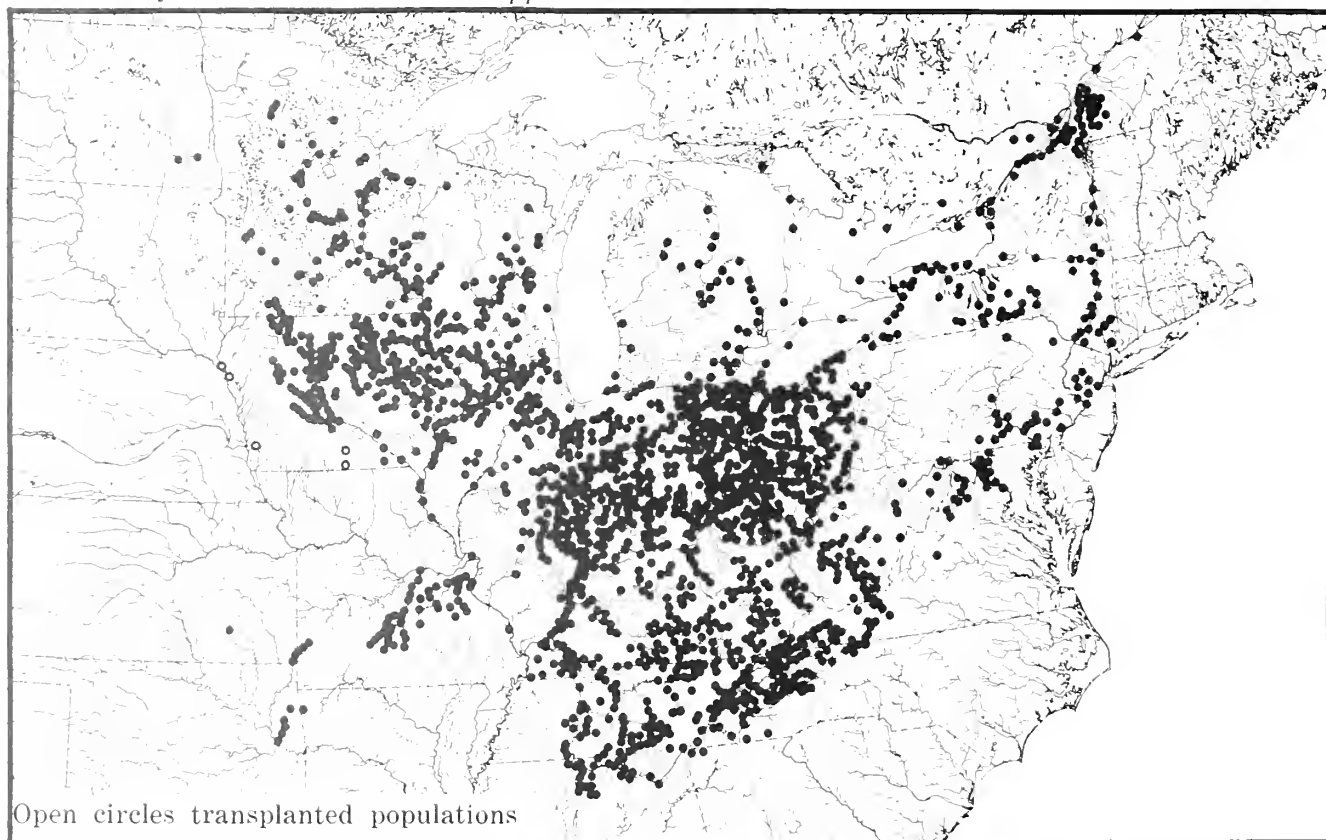
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: St. Joseph River, MI (Cope in Günther 1868. *Catalogue of the Fishes in the British Museum* 7:1-512).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1957. *Lloydia* 20:186-211) reviewed systematics of species, recognized subspecies *N. s. spilopterus* in east and *N. s. hypsisomatus* in west. These, however, are not usually recognized in publication. *Notropis spilopterus* was long considered only subspecifically distinct from *N. whipplei*, until Hubbs and Lagler (1943. *Invest. Indiana Lakes Streams* 2:73-83) showed them to be full species. Pflieger (1965. *Copeia*:1-8) discussed hybridization with *N. whipplei*.



(NCSM)



DISTRIBUTION AND HABITAT: Atlantic slope, from Potomac to Hudson river drainages, middle St. Lawrence drainage, most of Great Lakes basin (excluding Lake Superior drainage), and Mississippi River basin from northern MN south to north-eastern OK (Arkansas River drainage) and east to northern AL (Tennessee River drainage). In moderate to large, unvegetated streams (rarely major rivers) of moderate to high turbidity, with bottom of sand, gravel, or rubble. Often common to abundant.

ADULT SIZE: 47-106 mm TL.

BIOLOGY: Stone (1940. Ph.D. diss., Cornell Univ.) studied biology in western NY, Starrett (1950. *Ecology* 31:216-33; 1951. *Ecology* 32: 13-27) and Keeton (1963. Ph.D. diss., Iowa State Univ.) studied growth and diet in IA, and Minckley (1963. *Wildl. Monogr.* 11:1-124) reported on food in KY. Both sexes were found to live to two years consistently, with a few individuals (mostly females) reaching three, four, or even five years (Stone 1940; Keeton 1963). Both sexes mature at age I, though some individuals may not spawn until age II. Eggs are attached to branches and logs (usually the underside). Food consists mostly of terrestrial insects.

Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

Notropis stilbius (Jordan)
Silverstripe shiner

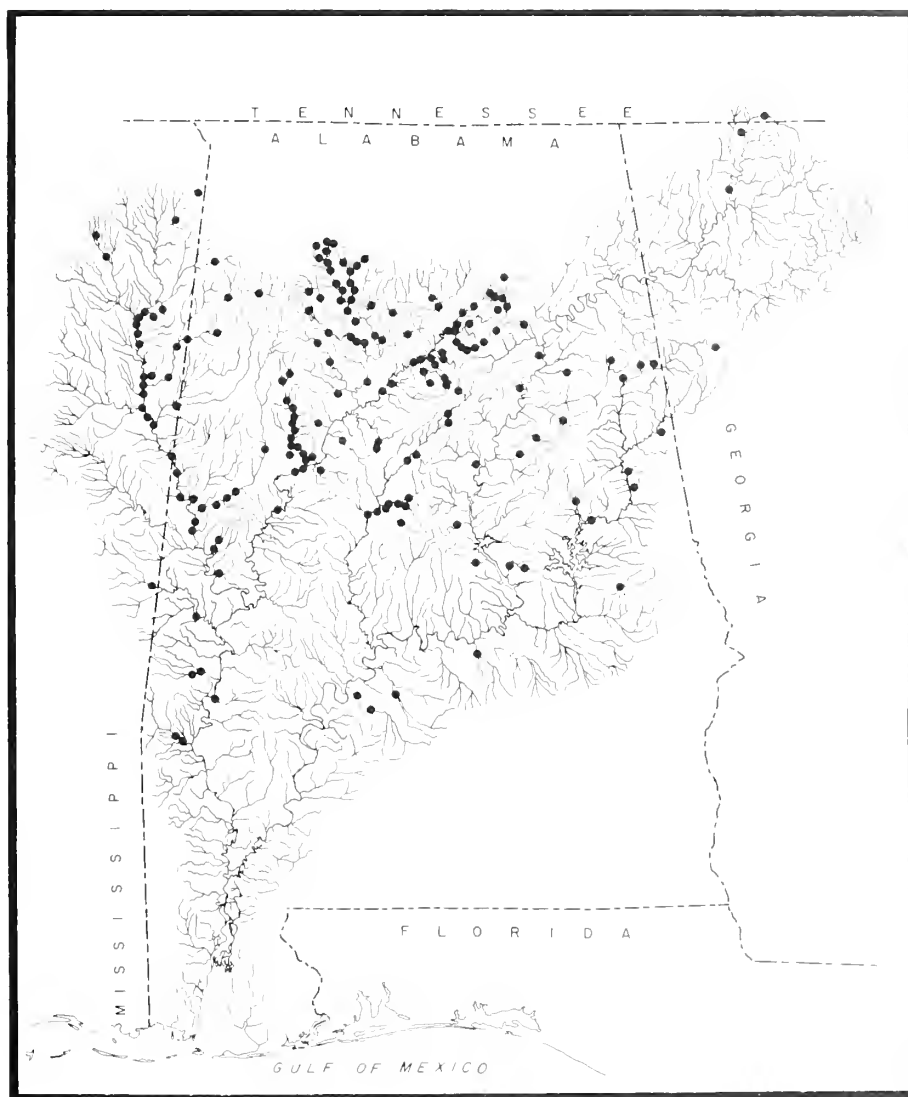
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Etowah, Oostanaula, and Coosa rivers, near Rome, Floyd Co., GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Subgenus *Notropis*. Allied with *N. atherinoides* complex.



GA: Haralson Co., Tallapoosa River (NCSM).



DISTRIBUTION AND HABITAT: Widespread in Mobile Basin, especially above Fall Line, in streams of moderate to large size. Single record from outside Mobile basin (Smith-Vaniz 1968. *Freshwater Fishes of Alabama*) based on one small specimen collected in 1952 from Bear Creek, Tennessee River. Habitat typically moderately flowing streams with gravel substrates, but also occupies slow running water over sand, and is often associated with *Justicia*.

ADULT SIZE: 74 mm SL maximum.

BIOLOGY: Based on examination of specimens throughout range, reproductive activity occurs from late March to early August, peaking in June. Insects are main food source.

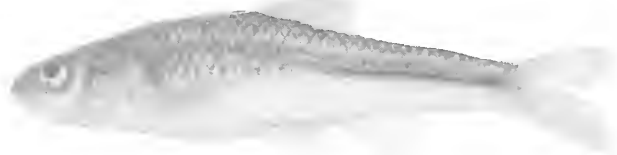
Compiler: H. T. Boschung. June 1979.

Notropis stramineus (Cope)
Sand shiner

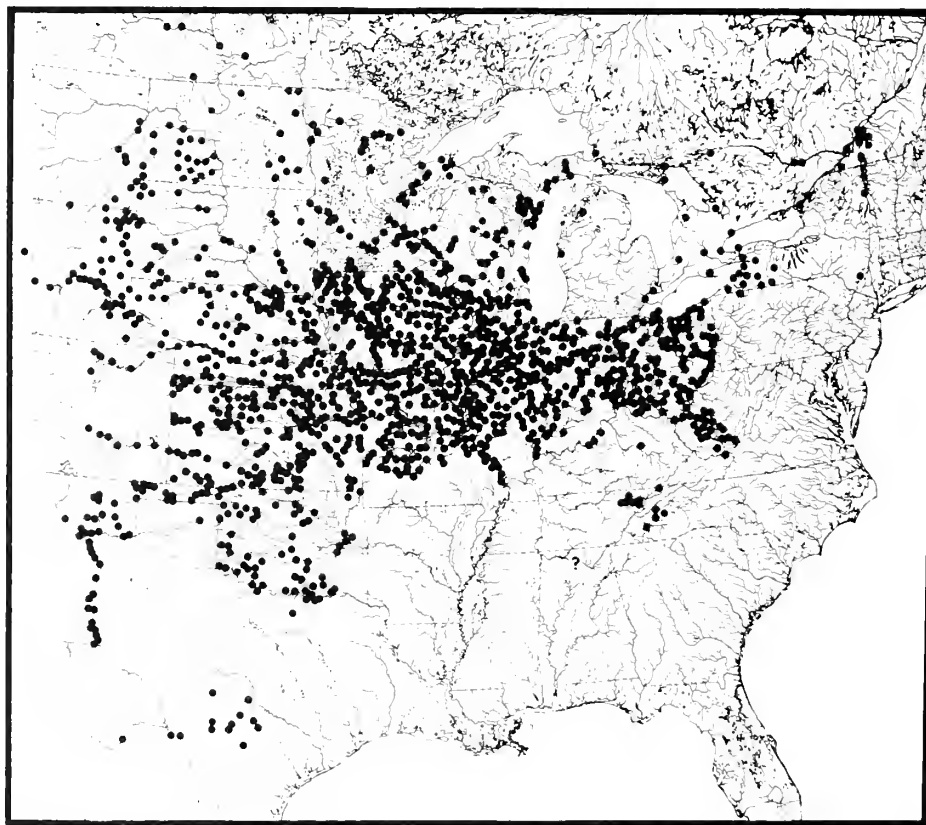
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Detroit River, Grosse Isle, MI (Cope 1865, Proc. Acad. Nat. Sci. Phila. [1864] 16:276-85).

SYSTEMATICS: Two distinct subspecies, eastern *N. s. stramineus* and western *N. s. missouriensis* (Bailey and Allum 1962, Misc. Publ. Mus. Zool. Univ. Mich. 119:1-131). Tan-yolac (1973, Occas. Pap. Mus. Nat. Hist. Univ. Kans. 12:1-28) confirmed this, and extended comparison throughout entire range. Erroneously called *N. blennius* prior to 1926, and subsequently (1926-1958) called *N. deliciosus*. Very similar in appearance and probably closely related to *N. volucellus*, with the two regarded as subspecies until Hubbs and Greene (1928, Pap. Mich. Acad. Sci. Arts Lett. [1927] 8:371-92) demonstrated their specific distinctness.



NM: Mora Co., Mora River at
Watsons, 57 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Gulf slope drainages in TX (Trinity River to Rio Grande drainages) northwest of Mississippi River (excluding LA and AR) into upper Mississippi Valley (including Missouri River basin), lower Red River of North drainage (in Canada), and lower Great Lakes east into upper Ohio River basin. From there ranges south into Tennessee River drainage of TN, where irregularly distributed. Occupies streams of diverse sizes, from small spring discharges to largest rivers, but found only rarely in upland areas. Usually associated with sandy substrate. Usually common, particularly in western plains area.

ADULT SIZE: 28-60 mm SL.

BIOLOGY: Summerfelt and Minckley (1969, Trans. Am. Fish. Soc. 98:444-53) and Tan-yolac (1973) published on biology and life history. Individuals may live three years, with those in year-class III disappearing by mid-summer. Total reproductive period extends from May or June through August, depending upon latitude, with variation in time of spawning more pronounced in *N. s. stramineus*. Range in egg complement (sub-species combined) 550-2600.

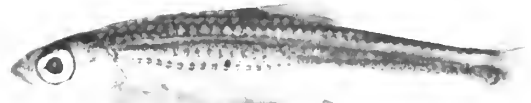
Compiler: C. R. Gilbert, November 1978.

Notropis telescopus (Cope)
Telescope shiner

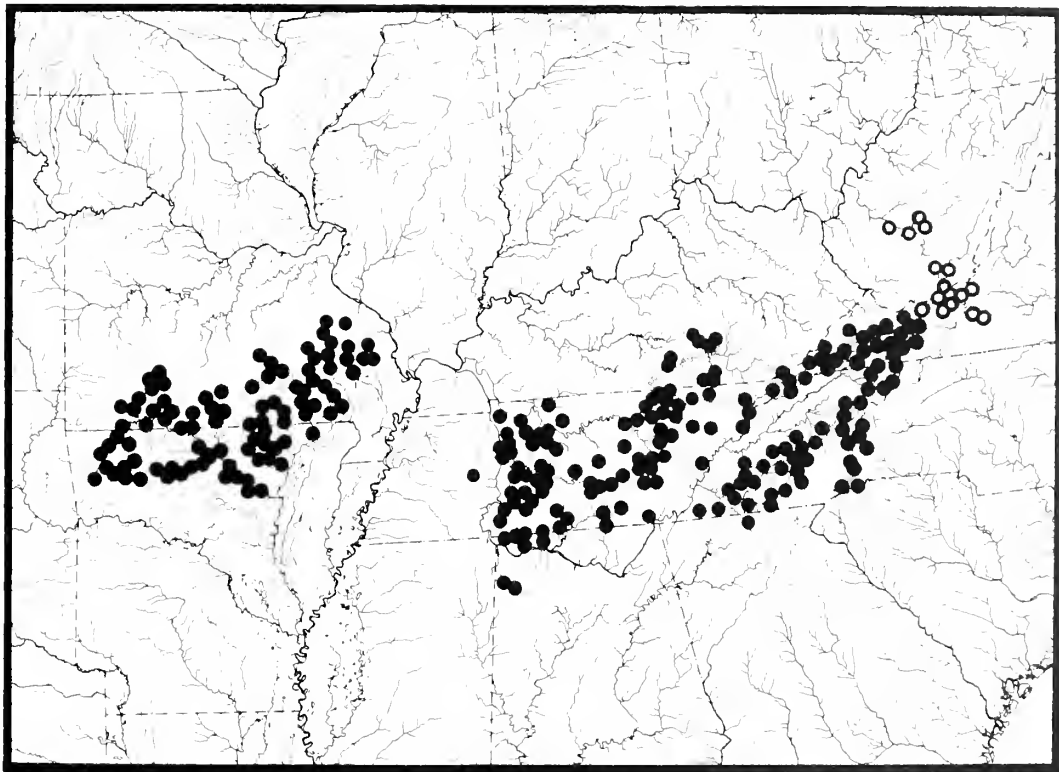
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Holston River and tributaries, VA (Cope in Günther 1868. *Catalogue of the Fishes in the British Museum* 7:1-512).

SYSTEMATICS: Subgenus undetermined. Gilbert (1969. *Copeia*:474-92) reviewed systematics of species. From 1939-1969 it was erroneously regarded as a subspecies of *N. ariommus*, and most literature references to latter during that period actually refer to *N. telescopus*.



TN: Blount Co., Tennessee
River system, 60 mm SL
(Smith-Vaniz 1968).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Upland areas both east and west of Mississippi River east to Tennessee drainage of AL, GA, and TN, north to Cumberland drainage of TN, NC, and VA, north to Cumberland drainage of TN and KY. West throughout much of White and Black river systems in AR and MO and adjacent drainages immediately east (St. Francis and Little systems). Apparently introduced to the New (upper Kanawha) drainage, VA and WV. Generally common. Usually near riffles with gravel or rocky bottom in clear, flowing waters of medium-sized upland creeks.

ADULT SIZE: 51-78 mm SL.

BIOLOGY: No comprehensive ecological or life history studies have been conducted on this species. Known information summarized by Gilbert (1969. *Copeia*:474-92) and Pflieger (1975. *The Fishes of Missouri*).

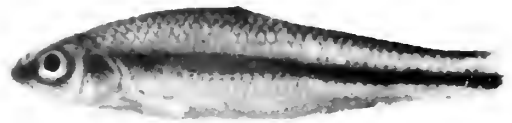
Compiler: C. R. Gilbert. March 1978.

Notropis texanus (Girard)
Weed shiner

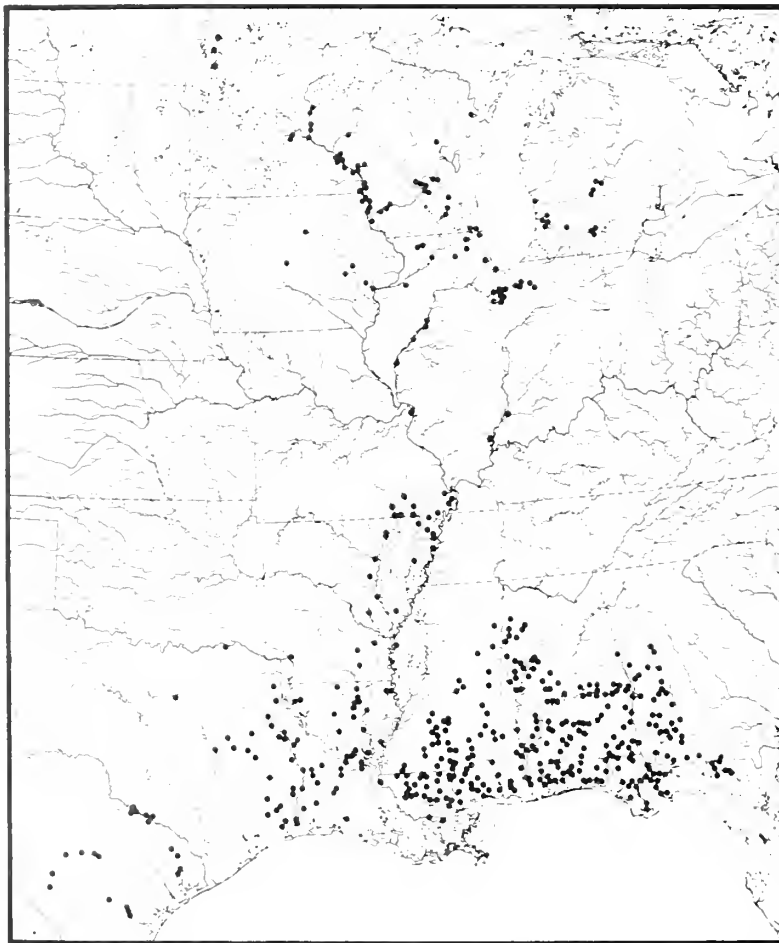
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Salado Creek, just e of San Antonio, Bexar Co., TX (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Swift (1970. Ph.D. diss., Florida State Univ.) studied systematics. Member of *N. texanus* species group, which includes *N. asperifrons*, *N. chalybaeus*, *N. hypsilepis*, and *N. petersoni*. Synonyms treated by Gilbert (1978. Bull. Fla. State Mus. Biol. Sci. 23:1-104). No subspecies recognized, but differentiated populations occur in upper Appalachian and Tombigbee drainages, and in areas north of IL (Swift 1970).



AL: Lee Co., Chattahoochee River system, male, 58 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Lowlands from Suwannee River, FL and GA, west to Nueces River in TX, north in Mississippi Valley (but not Ohio River basin) to Red River of the North, MN, and drainages of lakes Michigan and Huron. Common in south, rare north of AR. Mainly in open, sand-bottomed streams of widely varying sizes in south; streams to north have considerable aquatic vegetation. Common throughout most of range, but generally rare in north.

ADULT SIZE: 33-54 mm SL, 63 mm SL maximum.

BIOLOGY: Heins (1977. Am. Midl. Nat. 98: 491-95) studied age and growth and found that 60% of growth occurred by formation of first annulus. Breeds during March and April in FL, May in MO, and June in MI (Swift 1970). Most individuals live two plus years in MS, with few living over three years (Heins 1977).

Compiler: C. C. Swift, January 1979.

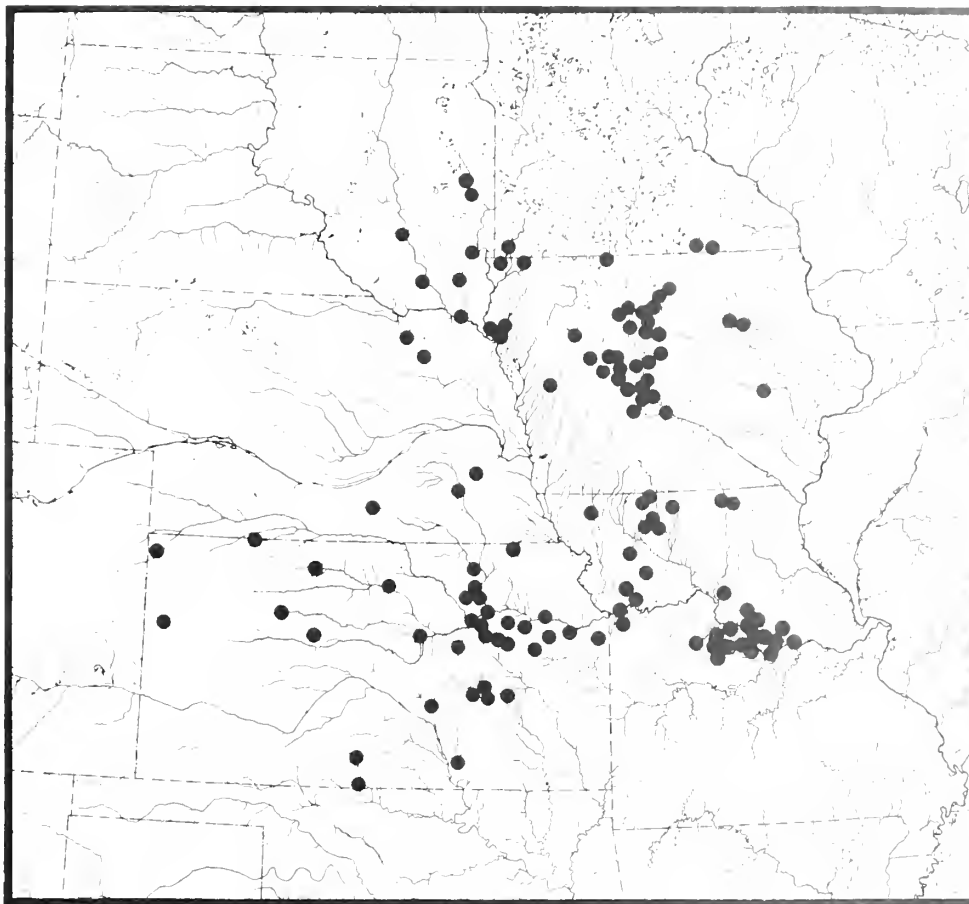
***Notropis topeka* (Gilbert)**
Topeka shiner

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Shunganunga Creek, tributary to Kansas River, Shawnee Co., KS (Gilbert 1884. Bull. Washburn Coll. Lab. Nat. Hist. 1:10-16).

SYSTEMATICS: Systematic relationships unclear. No study of geographical variation published.

SD: Minnehaha Co., tributary to Big Sioux River, 44 mm SL (NCSM).



Map modified from Bailey and Allum 1962

DISTRIBUTION AND HABITAT: Missouri, Mississippi, and Arkansas river drainages from southeastern SD and extreme southern MN south to central MO and extreme southern KS. Populations in western KS either extirpated or nearly so; also has disappeared from many other localities. Nowhere abundant, but a characteristic element of small streams in certain areas (e.g., central MO). Typically in quiet, open pools of small, clear streams that drain upland prairie areas. Bottom predominantly of gravel, with some rubble and sand. Increased siltation, turbidity and drying over most of range primarily responsible for decline. Metcalf (1966. Publ. Mus. Nat. Hist. Univ. Kans. 17:23-189) discussed zoogeographical origins and relationships.

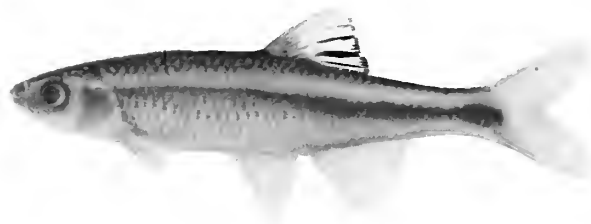
ADULT SIZE: ca. 35-55 mm SL, ca. 65 mm SL maximum.

BIOLOGY: Minckley and Cross (1959. Am. Midl. Nat. 61:210-17), Cross (1967. *Handbook of Fishes of Kansas*) and Pflieger (1975. *The Fishes of Missouri*) gave information on biology and life history. Spawning observed late May to mid-July in MO, usually over sunfish nests. Sexual maturity achieved during second summer, and normal life span does not exceed three years. Probably carnivorous, but food habits not studied.

Compiler: C. R. Gilbert. October 1978.

Notropis trichroistius (Jordan
and Gilbert)
Tricolor shiner

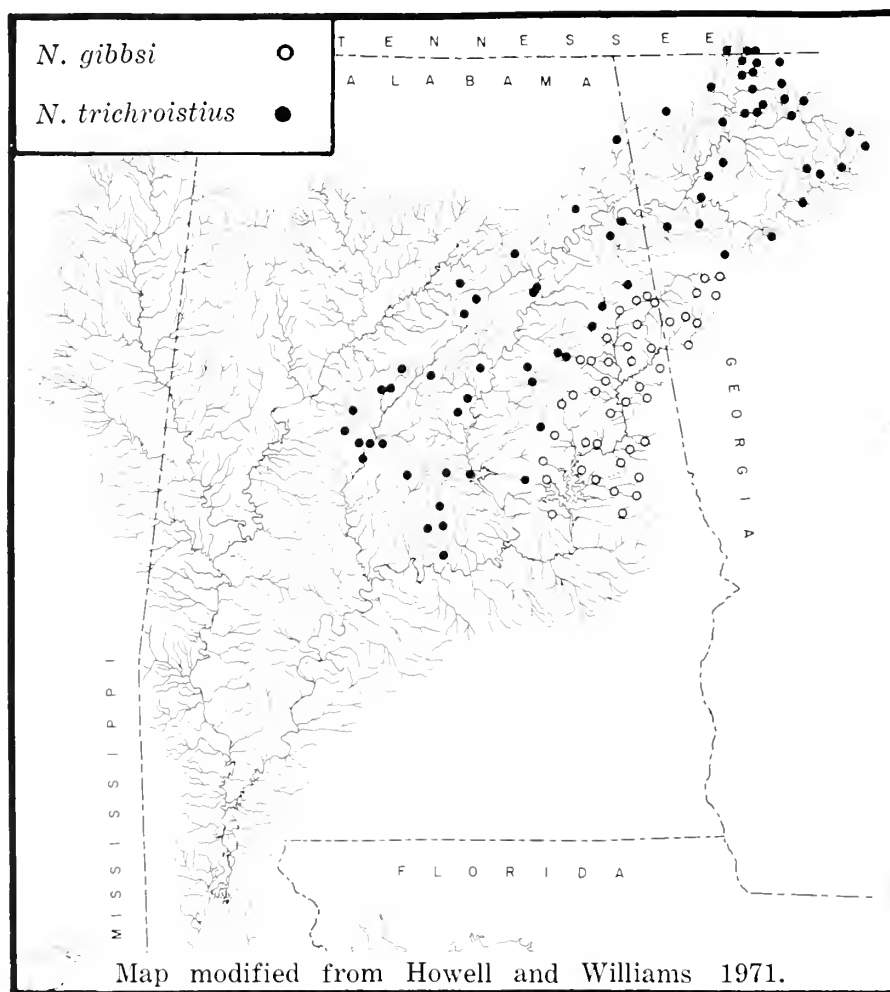
Order Cypriniformes
Family Cyprinidae



AL: Calhoun Co., Coosa River
system, male, 68 mm SL
(Smith-Vaniz 1968).

TYPE LOCALITY: Tributary of Etowah
River, GA; probably near Rome, Floyd Co.
(Jordan and Gilbert in Jordan and Brayton
1878. U.S. Natl. Mus. Bull. 12:1-95).

SYSTEMATICS: Subgenus *Cyprinella*. How-
ell and Williams (1971. Copeia:55-64) com-
pared this species with closely related allo-
patric *N. gibbsi*, previously considered a pop-
ulation of *N. trichroistius*. Gibbs (1955.
Ph.D. diss., Cornell Univ.) reviewed the
species. Howell and Williams (1971) con-
sidered these two species to be most closely
related to *N. pyrrhomelas* and *N. xaenurus*.



DISTRIBUTION AND HABITAT: Endemic
to Mobile River drainage, where it is nearly
confined to Coosa and Cahaba systems and
a few tributaries of Alabama River proper,
northeastern AL, northwestern GA, and
southeastern TN. Also occupies one small
area of Black Warrior system (believed to
have been reached by headwater stream cap-
ture). Generally common throughout range.

ADULT SIZE: 80 mm SL maximum.

BIOLOGY: No studies published.

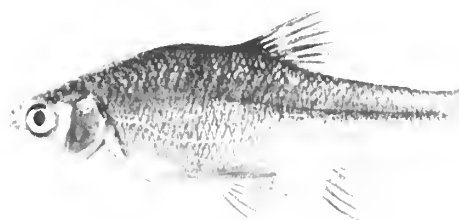
Compiler: C. R. Gilbert. August 1978.

Notropis umbratilis (Girard)
Redfin shiner

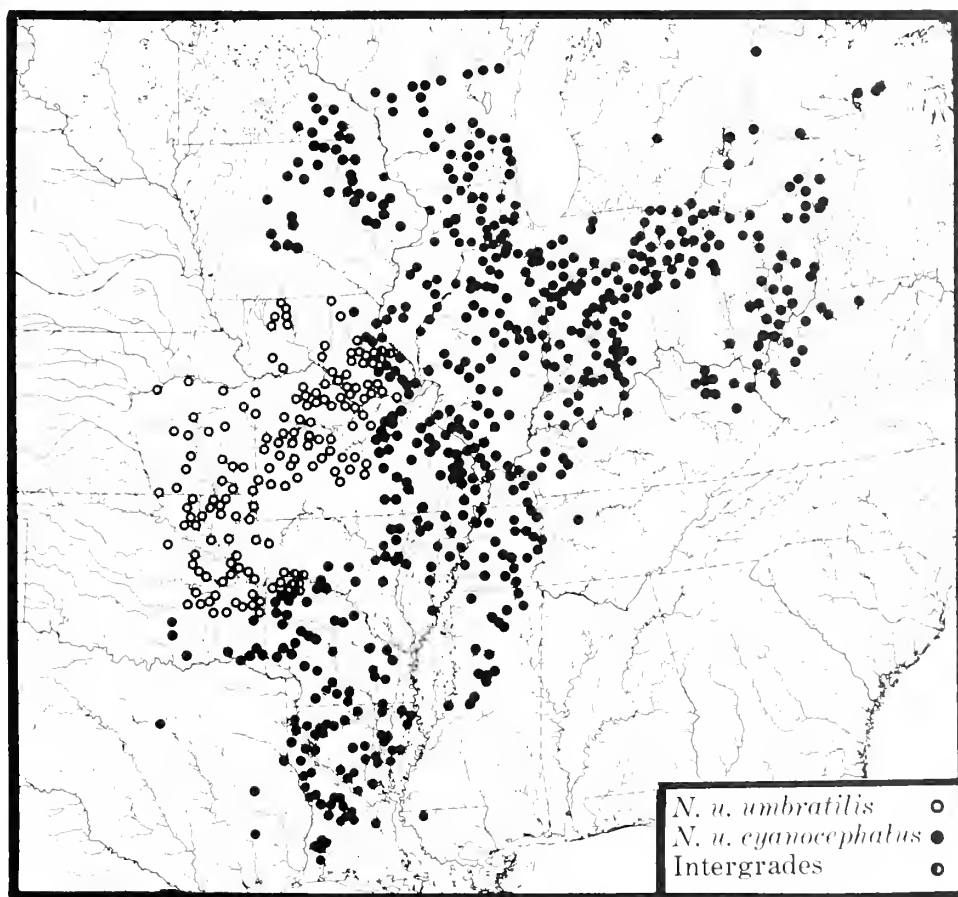
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Sugar Loaf Creek, tributary of Poteau River, Sebastian Co., AR (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Type species of subgenus *Lythrurus*. Two well-defined subspecies, *N. u. umbratilis* and *N. u. cyanocephalus*, which intergrade in Salt and Arkansas river systems. Generally *N. u. cyanocephalus* is eastern subspecies, *N. u. umbratilis* western. Snelson and Pflieger (1975. Copeia:231-49) reviewed systematics of species in central Mississippi River basin.



AR: St. Francis Co., Tuni Creek, 57 mm SL male (F. F. Snelson, Jr).



Map modified from Snelson and Pflieger 1975

DISTRIBUTION AND HABITAT: Widespread in Mississippi and Ohio valleys and in southern Great Lakes tributaries as far north as western NY, southern ON, southern MI and WI, and southeastern MN. South in Mississippi Valley to Red River drainage, but uncommon in tributaries east of Mississippi River. West to central KS and OK in Missouri, Arkansas, and Red drainages. Gulf coast drainages from Lake Pontchartrain west to San Jacinto. Complementary distributions of two subspecies in central Mississippi River basin shown by Snelson and Pflieger

(1975). Occupies small to medium-sized streams in varied ecological settings, from slow-flowing bayous to high-gradient upland streams.

ADULT SIZE: 40-67 mm SL.

BIOLOGY: Little known. Spawns over centrarchid nests. Breeding aggregations attracted and induced to spawn by odor of *Leptomis cyanellus* milt and ovarian fluid (Hunter and Hasler 1965. Copeia:265-81).

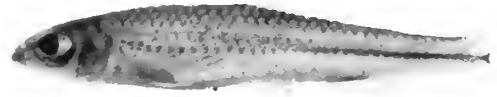
Compiler: F. F. Snelson, Jr, September 1978.

Notropis uranoscopus Suttkus
Skygazer shiner

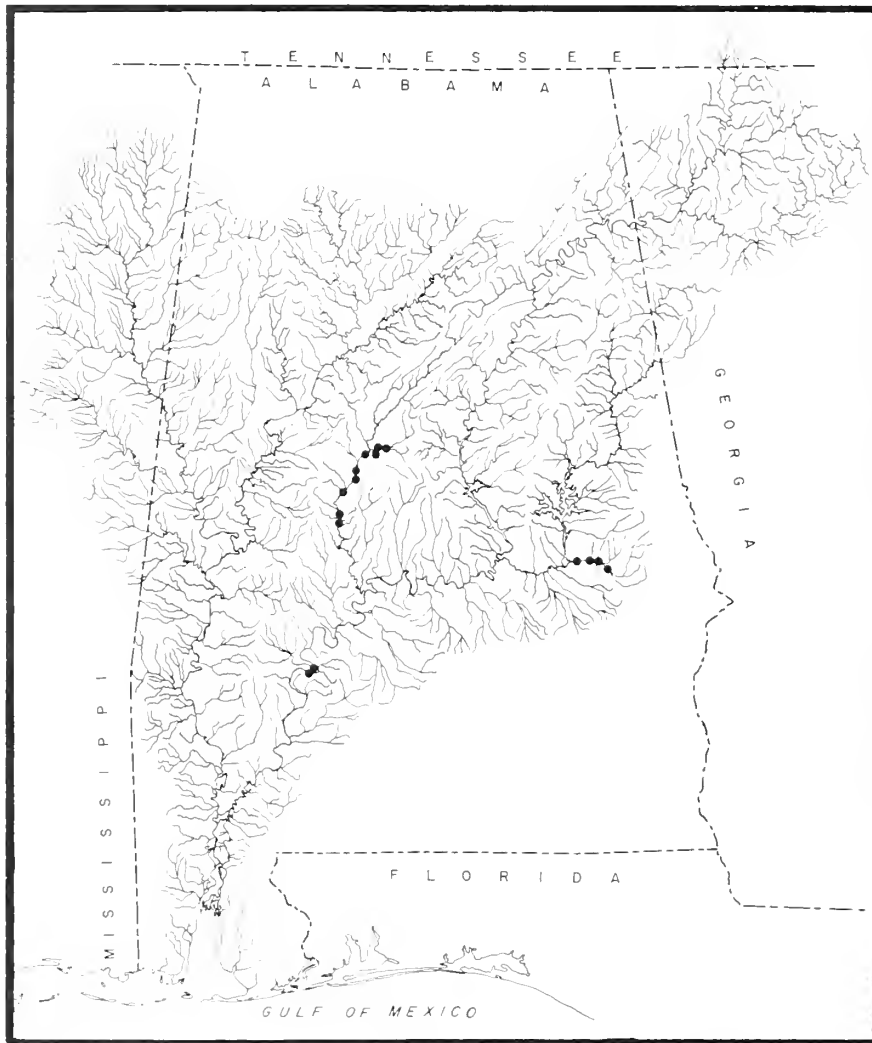
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Cahaba River, 3.5 km n Centerville, Bibb Co., AL (Suttkus 1959. Copeia: 7-11).

SYSTEMATICS: Often included in subgenus *Alburnops*, although several authors question this affiliation. Member of *N. stramineus* species group.



AL: Bibb Co., Cahaba River system, 45 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Confined to Mobile basin; disjunctly distributed in Cahaba (Cahaba River proper, Little Cahaba River, and Sixmile Creek), Tallapoosa (Uphapee Creek) systems and Alabama River proper. Most often in moderate to large streams where gravel is present and current is moderate to swift. Occasionally common in preferred habitat, but area of greatest abundance (Cahaba River) is under environmental stress.

ADULT SIZE: 57 mm SL maximum.

BIOLOGY: Based on gut contents of specimens collected in Cahaba River in October, food is predominantly filamentous algae, and to a lesser extent, insects. Combination of algae, benthic insects, sand and coal dust in gut suggests it is bottom feeder. Spawns April to September, probably peaking in June and July.

Compiler: H. T. Boschung. June 1979.

Notropis venustus (Girard)
Blacktail shiner

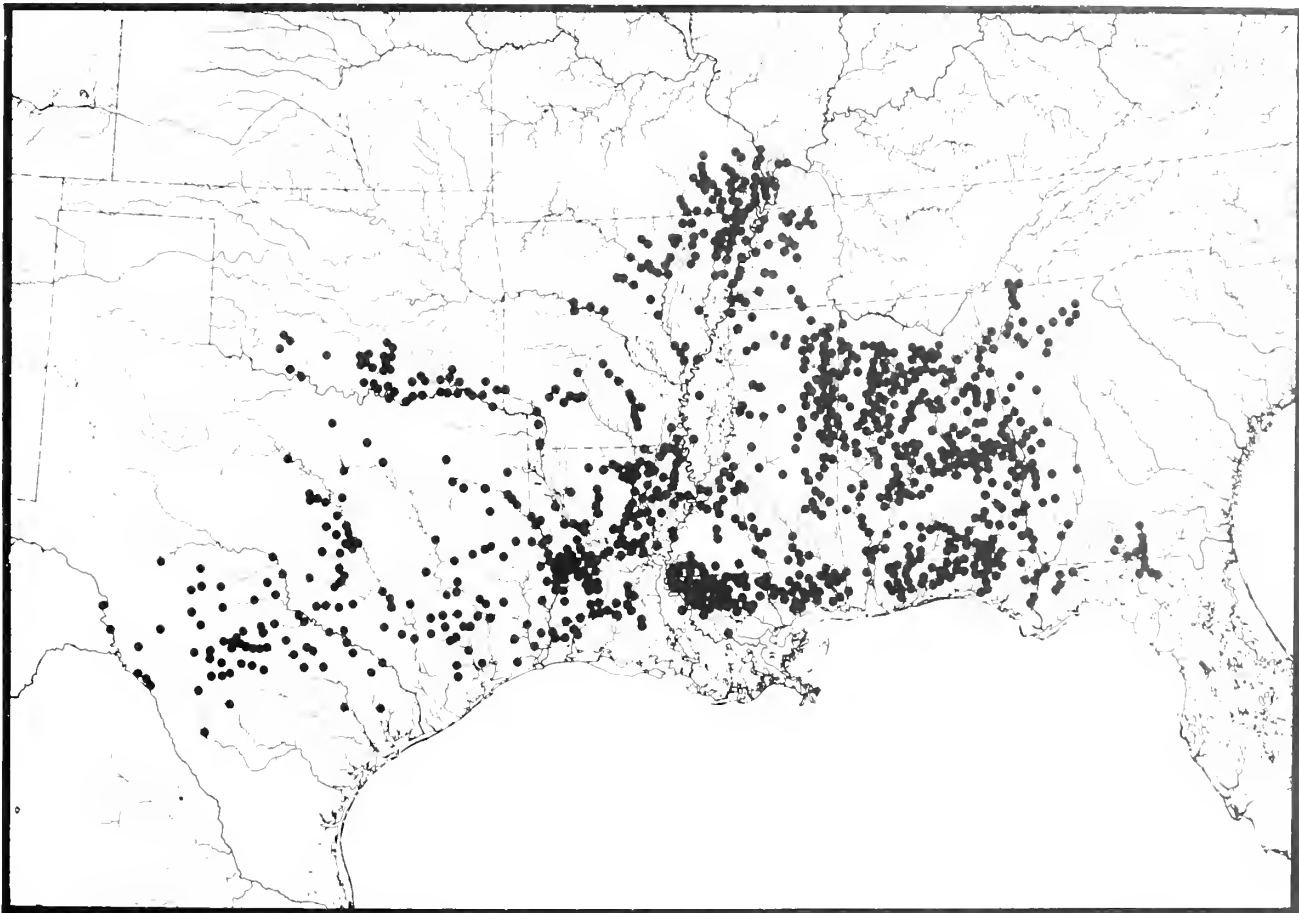
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Rio Sabinal, at Sabinal, Uvalde Co., TX (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1957. Tulane Stud. Zool. 5:175-203) reviewed species and recognized three subspecies (*N. v. venustus*, *N. v. cercostigma*, and *N. v. stigmaturus*), which differ most notably in lateral line scale count, body depth, caudal peduncle depth, and size and intensity of caudal spot. Often undergoes introgressive hybridization with *N. lutrensis*, particularly in areas of ecological disturbance (Hubbs et al. 1953. Tex. J. Sci. 5:216-44; Hubbs and Strawn 1956. Evolution 10:341-44).



MO: Stoddard Co., Bell City,
60 mm SL (Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: Rio Grande basin, TX, east to Suwannee River drainage, GA and FL. Subspecies *N. v. venustus* ranges from TX to western MS. *N. v. cercostigma* from southeastern LA and MS to FL, and *N. v. stigmaturus* in upper part of Mobile Bay basin. Intergrades between *N. v. cercostigma* and *N. v. stigmaturus* identified from Cahaba, Alabama, and Tallapoosa river drainages, AL. Most common habitat is clear, sandy-bottomed streams of moderately large size, but upland populations occur over substrates with more gravel and rubble. Populations

to west often occur in turbid waters. Abundant, particularly in LA and TX, where often is numerically dominant species.

ADULT SIZE: 152 mm SL maximum.

BIOLOGY: No comprehensive study published. Swingle (1965. Auburn Univ. Agri. Exp. Sta. Zool.-Ent. Ser. Fish. 3:1-87) studied length-weight relationships for nearly 3000 AL specimens.

Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

Notropis volucellus (Cope)
Mimic shiner

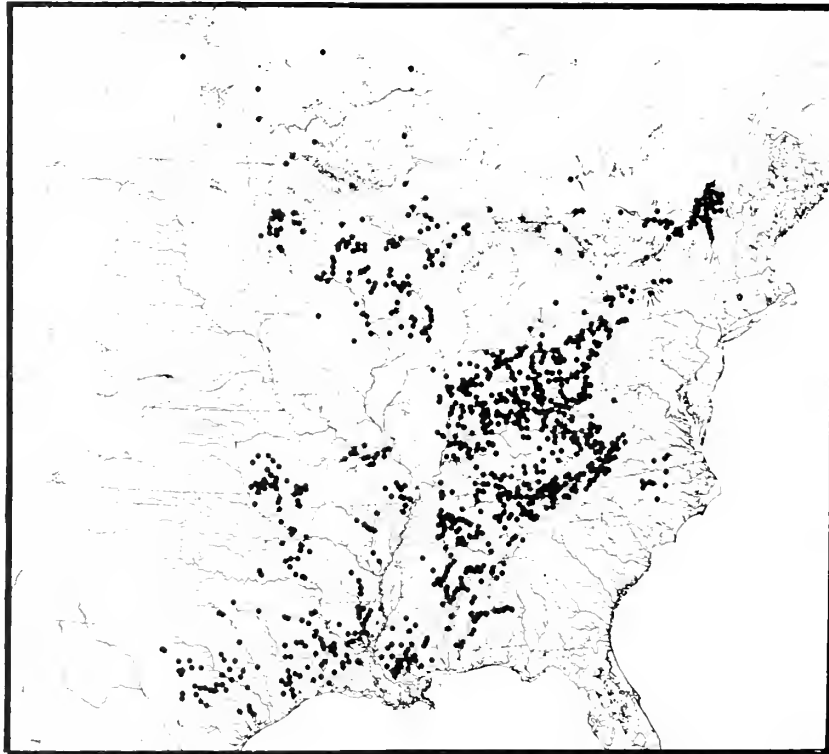
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Detroit River, at Grosse Ile, Wayne Co., MI (Cope 1865. Proc. Acad. Nat. Sci. Phila. [1864] 16:276-85).

SYSTEMATICS: No definitive study published. As here discussed and mapped, *N. volucellus* is a complex of species and subspecies, including form *wickliffi* (a large-river inhabitant) and undescribed Cahaba shiner, from AL. Among presently recognized and described species, *N. buchanani* is closest relative; the two were considered subspecies until shown by Bailey (in Harlan and Speaker 1951. *Iowa Fish and Fishing*: 187-238). to be specifically distinct. Other close relatives include *N. stramineus*, *N. procne*, and *N. heterolepis*.



MO: Ste. Genevieve Co., Mississippi River at Brickleys, 37 mm SL (Mo. Dept. Cons.).



DISTRIBUTION AND HABITAT: Guadalupe and San Antonio river systems, TX, east to Mobile Bay basin, AL. Widespread throughout most eastern drainages of Mississippi basin (largely extirpated from IL), but confined to lower parts of western drainages (eastern OK, southeastern KS, eastern MO and IA) north to eastern MN and WS. Throughout most of Great Lakes drainages east to St. Lawrence drainage (vicinity of Montreal) and Lake Champlain system, VT and NY. Also in Red River of North drainage, in MB and ON, but apparently absent from southern parts of drainage in MN, ND, and SD. Distribution of form *wickliffi* mapped and/or discussed in works for OH, IN, IL, WS, IA, MO, and KY; confined to main channels of very large, moderately clear to highly turbid rivers.

Form *volucellus* inhabits clear streams, from medium-sized creeks to small rivers, and is most abundant near riffles in current. Both forms often common in preferred habitat.

ADULT SIZE: 38-76 mm TL.

BIOLOGY: Black (1945. Invest. Indiana Lakes Streams 2:449-69) studied life history in IN lakes, and Olmsted et al. (1979. Copeia:437-41) studied feeding behavior in AR. In IN, spawns in late June and early July, and eggs broadcast over weed beds (in lakes). Food consists of large entomostacans, insect larvae, and algae. Lives two years.

Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

Notropis welaka Evermann and
Kendall
Bluenose shiner

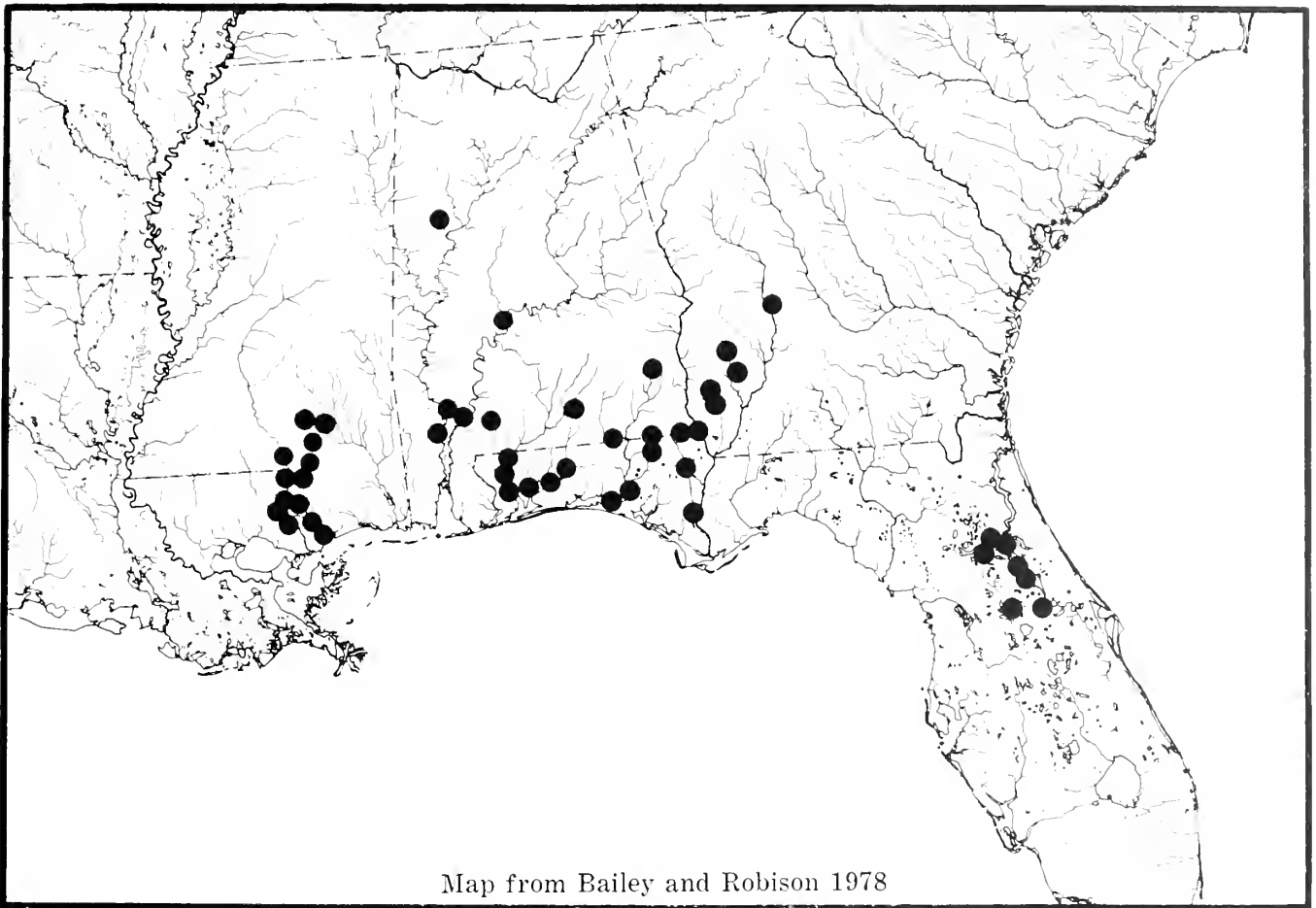
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: St. Johns River near Welaka, Putnam Co., FL (Evermann and Kendall 1898. Bull. U. S. Fish Comm. [1897] 17:125-33).



SYSTEMATICS: Bailey and Robison (1978. Occas. Pap. Mus. Zool. Univ. Mich. 683:1-21) reviewed systematics and compared it with closely related *N. hubbsi*. Relationships of these to other species of *Notropis* uncertain.

FL: Gulf Co., Chipola River system, 47 mm SL (Smith-Vaniz 1968).



Map from Bailey and Robison 1978

DISTRIBUTION AND HABITAT: Outer Gulf slope from Pearl River drainage, LA and MS, east to St. Johns River drainage, FL. Wide distributional hiatus between St. Johns population and next closest west, in Apalachicola River drainage. Also apparently absent from Escatawpa River drainage. Inhabits deep, slow-moving coastal streams of varying clarity and usually with silty bottoms, often heavily choked with brush and vegetation. Seems to prefer deep pools

to more shallow areas. Spotty in occurrence and not considered a common species, but apparent rarity may be due to difficulty of sampling preferred habitat.

ADULT SIZE: ca. 53 mm SL maximum.

BIOLOGY: No published detailed studies.

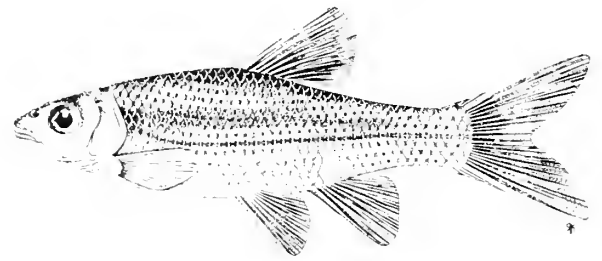
Compiler: C. R. Gilbert. August 1978.

Notropis whipplei (Girard)
Steelcolor shiner

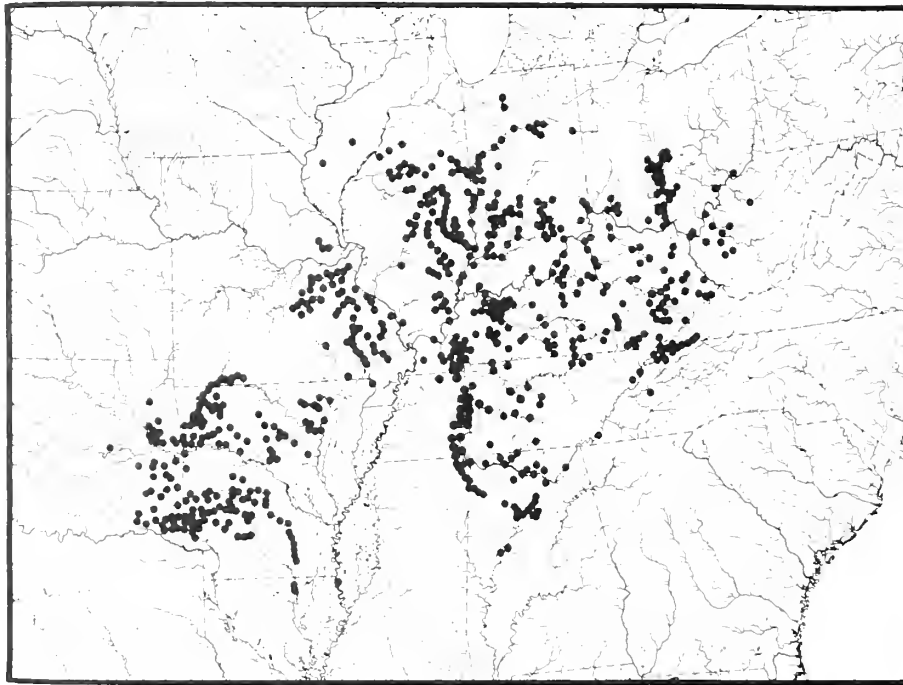
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Sugarloaf Creek (tributary to Poteau River), ca. 32-40 km s of Fort Smith, AR, vicinity of Poteau, OK (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1963. Copeia:511-28) reviewed species. Most closely related to *N. analostanus*, which is allopatric geminate on Atlantic slope. Also apparently closely related to *N. camurus*, which is morphologically very similar (particularly the young) and with which it occurs sympatrically and presumably syntopically in lower Mississippi Valley. Long considered only subspecifically distinct from *N. spilopterus* until Hubbs and Lagler (1943. Invest. Indiana Lakes Streams 2: 73-83) showed them to be full species. Pflieger (1965. Copeia:1-8) discussed hybridization with *N. spilopterus*.



(NCSM)



DISTRIBUTION AND HABITAT: Lower half of Ohio River drainage, OH and WV, south to Tennessee River drainage AL, MS, and TN. Also in Black Warrior system (Mobile Bay basin), AL. In independent tributaries of Mississippi River, TN and MS, west to Ouachita River drainage, LA and AR, and Red River drainage, OK, north to lower Missouri River drainage, MO. Occurs in moderate to large, unvegetated streams (rarely major rivers) of moderate to high turbidity, and with bottom of sand, gravel, or rubble. Often common.

ADULT SIZE: 41-135 mm TL.

BIOLOGY: Lewis and Gunning (1959. Trans. Ill. Acad. Sci. 52:59-64) studied life history in IL. Individuals there live at least to age II and spawn from July to September. Spawning occurs around logs, brush, etc., and eggs are attached in clusters to undersides of obstructions. Pflieger (1965) found spawning habits, time, place, and behavior very similar to those of *N. spilopterus*, but hybridization in nature between the two species is very rare. Insects (primarily terrestrial) were principal food items of 30 specimens examined from IL (Lewis and Gunning 1959).

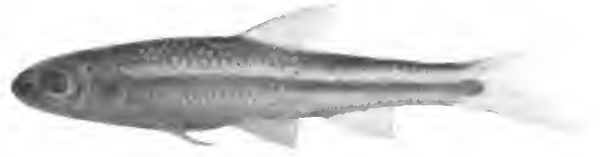
Compilers: C. R. Gilbert and G. H. Burgess.
October 1979.

Notropis xenocephalus (Jordan)
Coosa shiner

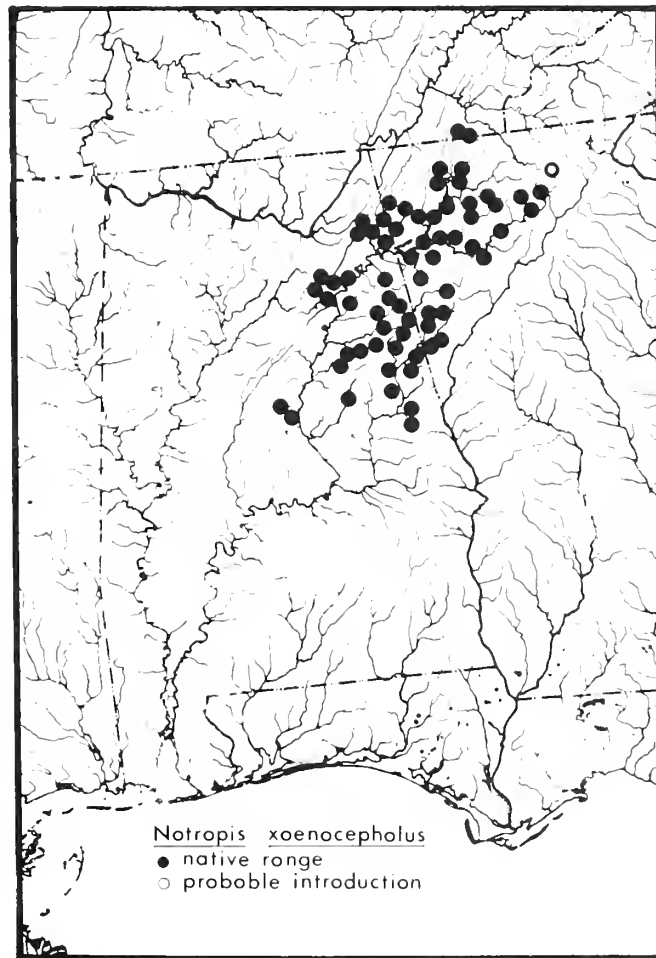
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributaries of Etowah River near Rome, GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Swift (1970. Ph.D. diss., Florida State Univ.) and Suttkus and Raney (1955. Tulane Stud. Zool. 3:1-33) studied systematics. Probably not closely related to *N. texanus*, but rather to more northern up-land species such as *N. boops* (Swift 1970).



AL: Calhoun Co., Coosa River system, 52 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Coosa and Tallapoosa systems (Mobile drainage), above Fall Line in clear, cool, often spring-fed creeks. Occupies surface to bottom (Bailey et al. 1954. Proc. Acad. Nat. Sci. Phila. 56:109-64; Suttkus and Raney 1955; Swift 1970). Usually common.

ADULT SIZE: 40-63 mm SL.

BIOLOGY: Little known. Breeds May to July, based on museum material (Swift 1970).

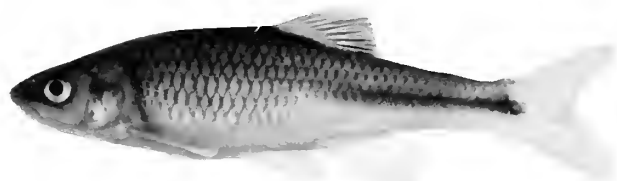
Compiler: C. C. Swift. January 1979.

Notropis xaenurus (Jordan)
Altamaha shiner

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: South Fork of Ocmulgee River, at Flat Shoals, DeKalb Co., GA (Jordan 1877. Proc. Acad. Nat. Sci. Phila. 29:76-82).

SYSTEMATICS: Subgenus *Cyprinella*. Gibbs (1955. Ph.D. diss., Cornell Univ.) studied systematics of subgenus and determined *N. pyrrhomelas* (Gibbs 1957. Copeia:185-95) to be closest probable relative.



GA: Oconee Co., Apalachee River, 86 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to upper areas of Altamaha River drainage in north-central GA, where occurs in both Ocmulgee and Oconee systems. Most often taken in moderate-sized streams, where seems to prefer pools behind obstacles along or under banks. Common in preferred habitat.

ADULT SIZE: Not reported. Maximum size ca. 90 mm SL.

BIOLOGY: Not studied.

Compiler: C. R. Gilbert. December 1978.

Notropis zonatus (Agassiz)
Bleeding shiner

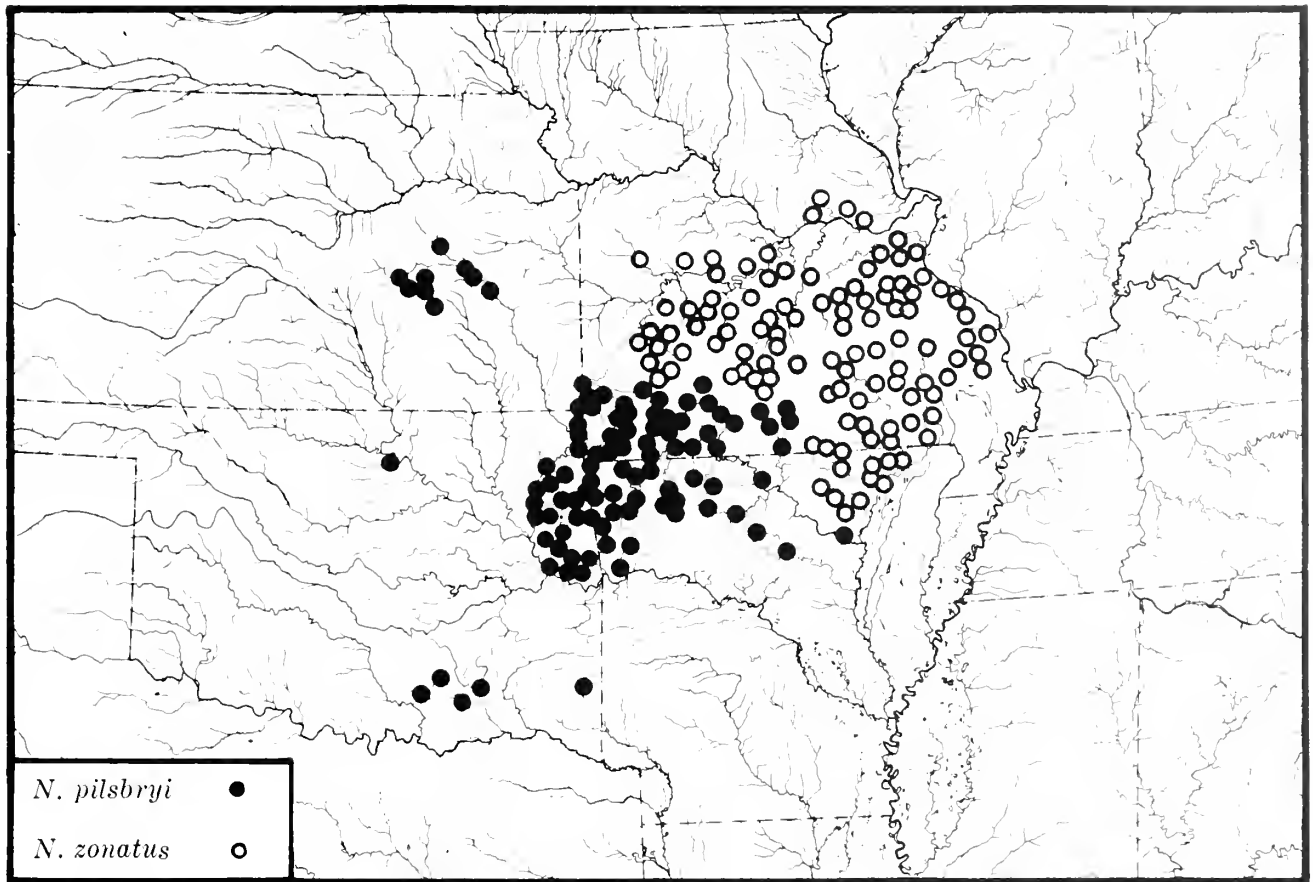
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Osage River (presumably in MO) (Agassiz in Putnam 1863. Bull. Mus. Comp. Zool. 1:1-16).

SYSTEMATICS: Subgenus *Luxilus*. Gilbert (1964. Bull. Fla. State Mus. Biol. Sci. 8:95-194) reviewed systematics and separated it specifically from closely related *N. pilsbryi*, formerly regarded as subspecies. Menzel and Cross (1977. Abstr. 57th Ann. ASIH meetings) recommended recognition of *N. zonatus* and *N. pilsbryi* as subspecies, based on biochemical similarities, but Buth (in press. Biochem. Syst. Ecol.), who also studied biochemical properties, favored their continued recognition as full species.



MO: Shannon Co., Current River, 70 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Tributaries of lower Missouri River in MO, south to Black, St. Francis, and Little river systems in MO and AR, and to a few small tributaries of Mississippi River in eastern MO. Typically inhabits small to medium-sized streams with gravel-rubble substrate and clear, rapidly-flowing water. Often most common fish present.

BIOLOGY: Pflieger (1975. *The Fishes of Missouri*) reviewed biology. Spawns in MO from late April to early July (mostly May and early June), over gravel nests of *Nocomis biguttatus* or in small, pit-like depressions excavated by males in clear, gravel riffles. Individuals seldom live more than three years. Feeds largely on insects and other invertebrates at surface or mid-water.

ADULT SIZE: ca. 85 mm SL maximum.

Compiler: C. R. Gilbert. August 1978.

Notropis zonistius (Jordan)
Bandfin shiner

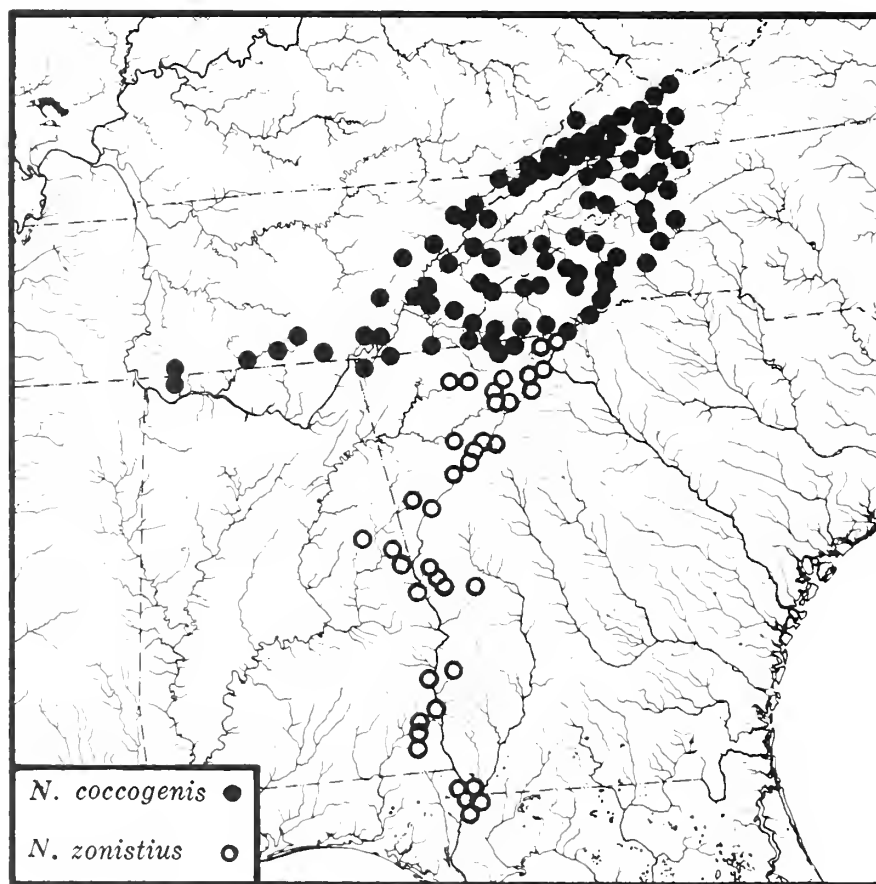
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Suwannee Creek, tributary to Chattahoochee River, ca. 12.9 km nw of Lawrenceville, Gwinnett Co., GA (Jordan 1880. Proc. U.S. Natl. Mus. 2:235-41).

SYSTEMATICS: Subgenus *Luxilus*, Gilbert (1964. Bull. Fla. State Mus. Biol. Sci. 8:95-194) studied systematics of species and showed closest relative to be *N. coccogenis*. Menzel (1976. Biochem. Syst. Ecol. 4:281-93) and Buth (in press. Biochem. Syst. Ecol.) studied biochemical relationships.



GA: Habersham Co., Chattahoochee River system, male, 72 mm SL (Smith-Vaniz 1968).



Map modified from Gilbert 1964

DISTRIBUTION AND HABITAT: Largely restricted to Chattahoochee River system of Apalachicola River drainage. Also in upper Savannah and upper Altamaha river drainages, where possibly native. Presumably introduced into upper Coosa and Tallapoosa river systems of Mobile Bay drainage. Inhabits small to medium-sized, usually clear streams with rubble-gravel or sand-gravel substrate and no aquatic vegetation. Usually common.

ADULT SIZE: ca. 85 mm SL maximum.

BIOLOGY: No detailed studies available.

Compiler: C. R. Gilbert. August 1978.

Orthodon microlepidotus (Ayres)
Sacramento blackfish

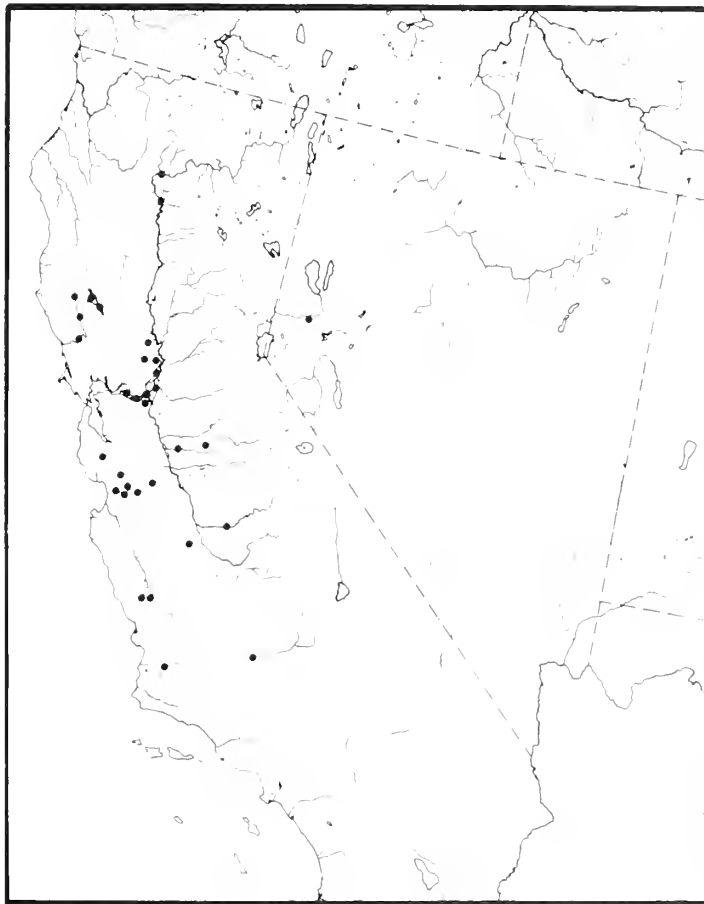
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: San Francisco Market, but probably caught in lower Sacramento River (Ayres 1854, Daily Placer Times and Transcript, May 30. Repeated 1857 in Proc. Calif. Acad. Sci. [1854-57] 1:3-22).

SYSTEMATICS: Monotypic and very distinctive from other endemic minnows. Hybridizes with *Lavinia exilicauda* and *Gila bicolor*. Coad (1976, Ph.D. diss., Univ. Ottawa) considered *Orthodon* most closely related to *Gila*.



CA: Yolo Co., Putah Creek, juvenile, 14 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Warm, eutrophic backwaters, sloughs, lakes (including Clear Lake, Lake Co., CA), and reservoirs of Sacramento-San Joaquin drainage, including Pajaro-Salinas system and lower Russian River. Absent from Pit River system, but possibly established through introductions in Truckee Meadows area of NV and Carmel River of southern CA.

BIOLOGY: Feeds on phytoplankton and detritus. Life history summarized in Moyle (1976, *Inland Fishes of California*). Important commercial species in CA with considerable potential for aquaculture.

ADULT SIZE: 250-450 mm SL.

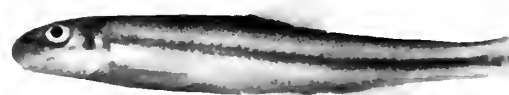
Compiler: P. B. Moyle, July 1978.

***Phenacobius catostomus* Jordan**
Riffle minnow

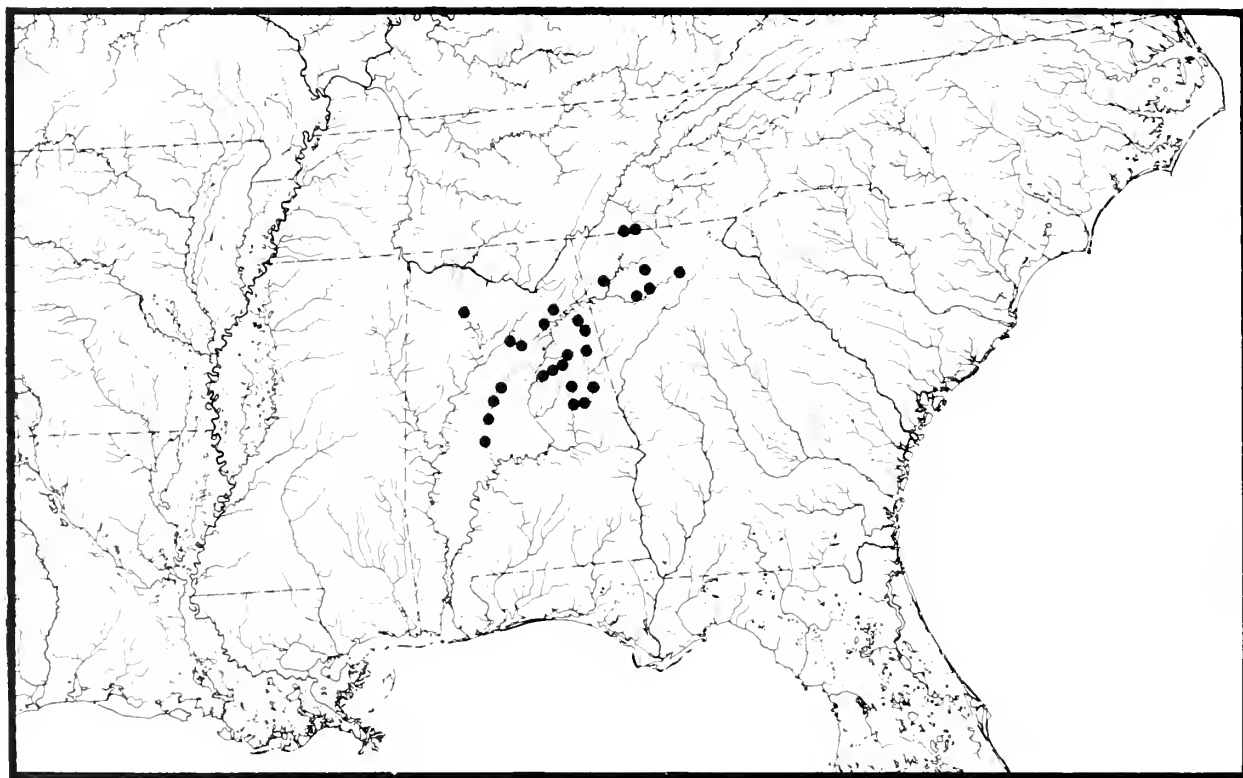
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Silver Creek, just above its mouth in Etowah River, Floyd Co., GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. [1876] 11:307-77).

SYSTEMATICS: *Phenacobius* is closely related to certain species of *Erimystax* and to *Macrhybopsis*, currently subgenera of *Hybopsis* (Jenkins and Lachner 1971. Smithsonian Contrib. Zool. 90:1-15). Minckley and Craddock (1962. Copeia: 369-77) noted resemblances between *Phenacobius* and unspecified species of *Hybopsis* (*sensu lato*), but thought *Phenacobius* more closely aligned with *Exoglossum* (including *Pareroglossum*). Nearest relatives of *P. catostomus* are *P. crassilabrum* and *P. uranops* (Minckley and Craddock 1962). Considered monotypic species.



AL: Cleburne Co., Tallapoosa River system, 73 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Endemic to certain upper and middle sections of Mobile River drainage, AL, GA, and TN. Apparently localized in Black Warrior and, possibly, Tallapoosa systems. Widespread in Cahaba and Coosa systems, although probably not continuously distributed in latter due partly to impoundments. Inhabits gravel and rubble-bottomed runs and riffles of medium to large, warm streams. Sometimes common, but most series listed by Minckley and Craddock (1962) contain few specimens.

ADULT SIZE: 55-95 mm SL.

BIOLOGY: Virtually unknown. Swingle (1965. Auburn Univ. Agr. Exp. Sta. Zool. Ent. Ser. Fish 3:1-87) gave length-weight of three specimens. Spawns in spring, based on tubercle development.

Compiler: R. E. Jenkins. February 1979.

Phenacobius crassilabrum Minckley
and Craddock
Fatlips minnow

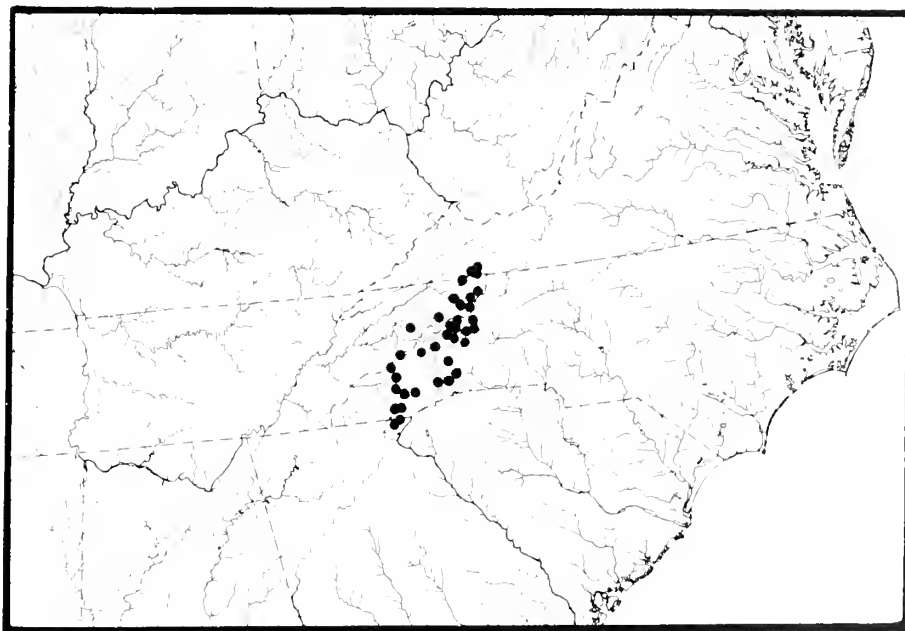
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Elk River, tributary to Watauga River, 36°18'N, 81°57'53 W, Carter Co., TN (Minckley and Craddock 1962. Copeia:369-77).

SYSTEMATICS: Probably most closely related to the other two fine-scaled species of *Phenacobius*: *P. catostomus* and *P. uranops* (Minckley and Craddock 1962). Considered monotypic species.



NC: Buncombe Co., French
Broad River drainage, 71 mm
SL (J.L. Harris).



Map modified from Minckley and Craddock 1962

DISTRIBUTION AND HABITAT: Endemic to Blue Ridge province section of upper Tennessee River drainage, from Little Tennessee system, GA and NC, north to South Fork Holston system, VA. Occupies runs and riffles in medium-sized, cool to warm, usually clear, rocky streams. Occasionally common.

BIOLOGY: Essentially unknown. Apparently spawns in spring, based on tubercle development.

ADULT SIZE: 60-90 mm SL.

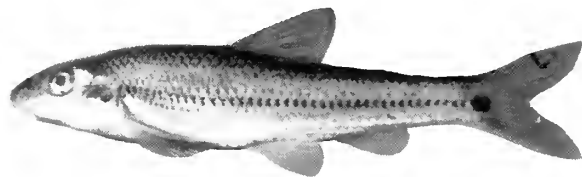
Compiler: R. E. Jenkins. February 1979.

Phenacobius mirabilis (Girard)
Suckermouth minnow

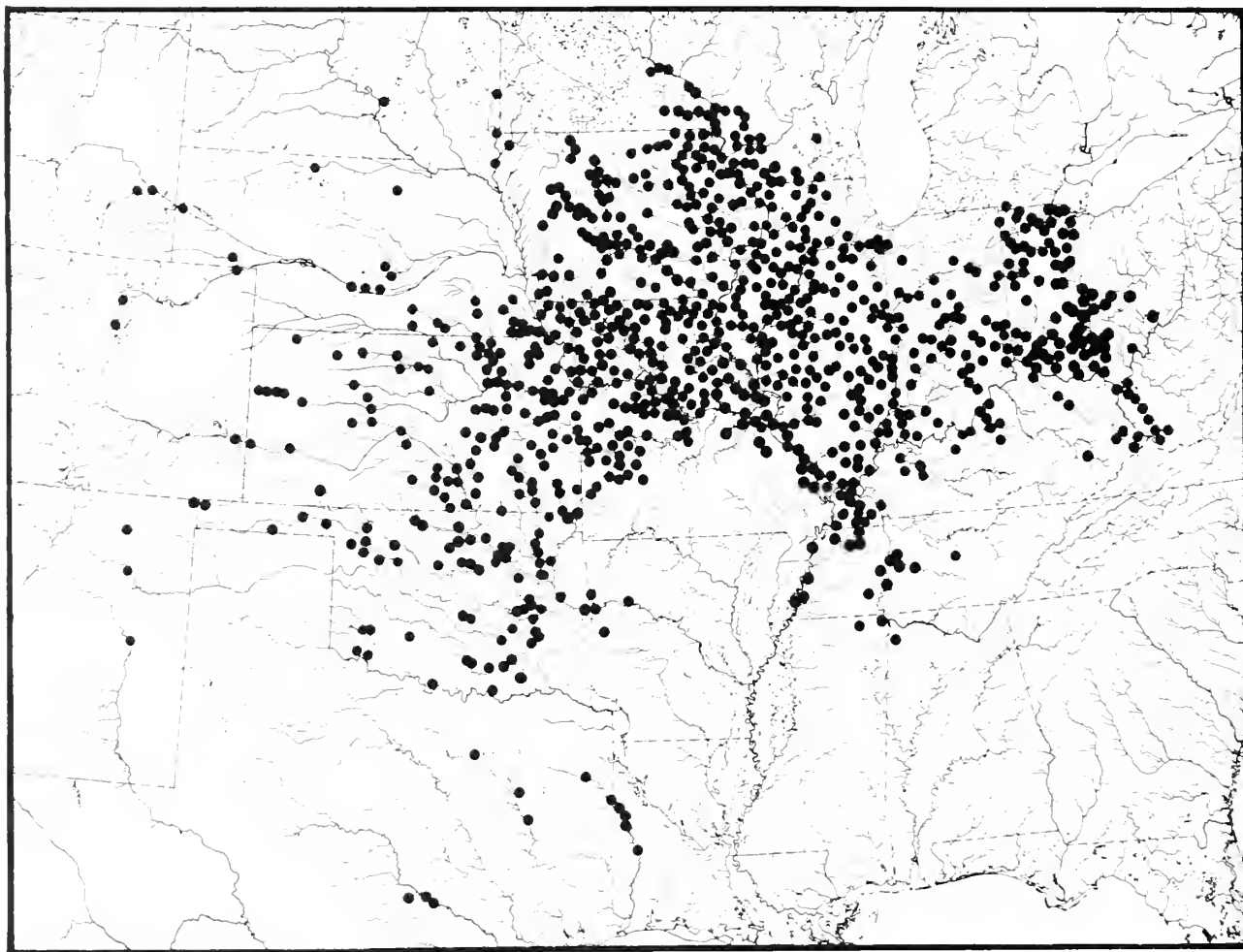
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Arkansas River, Fort Smith, AR (Girard 1857, Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Genus *Phenacobius* thought to be closely allied to *Exoglossum* (Moore 1968, in Blair et al. *Vertebrates of the United States*), but Minckley and Craddock (1962, *Copeia*:369-77) noted a striking resemblance to *Hybopsis*. Distribution of *P. mirabilis* suggests that it evolved in an Ancestral Plains Stream (Metcalf 1966, Univ. Kans. Publ. Mus. Nat. Hist. 17:23-189).



MO: Cooper Co., Moniteau Creek, 60 mm SL (Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: Gulf slope in NM, TX, and western LA, north in Mississippi River basin to WY, SD, and WI, and east in Ohio and Tennessee river valleys to eastern KY, western WV and eastern OH; also in western drainage of Lake Erie. Has extended range east in historic times, presumably correlated with increased siltation and turbidity (Trautman 1957, *The Fishes of Ohio*). Common to abundant plains species tolerant of moderate turbidity, but prefers riffles with a sand or gravel bottom.

ADULT SIZE: 31-60 mm SL.

BIOLOGY: Mature as yearlings and spawn in late spring to early summer (Starrett 1951, *Ecology* 32:13-27). Diet reported to consist of immature stages of aquatic insects, along with small quantities of bottom ooze. Food obtained by rooting in gravel (Starrett 1950, *Ecology* 31:216-33).

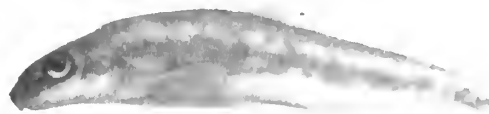
Compiler: F. C. Rohde, April 1978.

Phenacobius teretulus Cope
Kanawha minnow

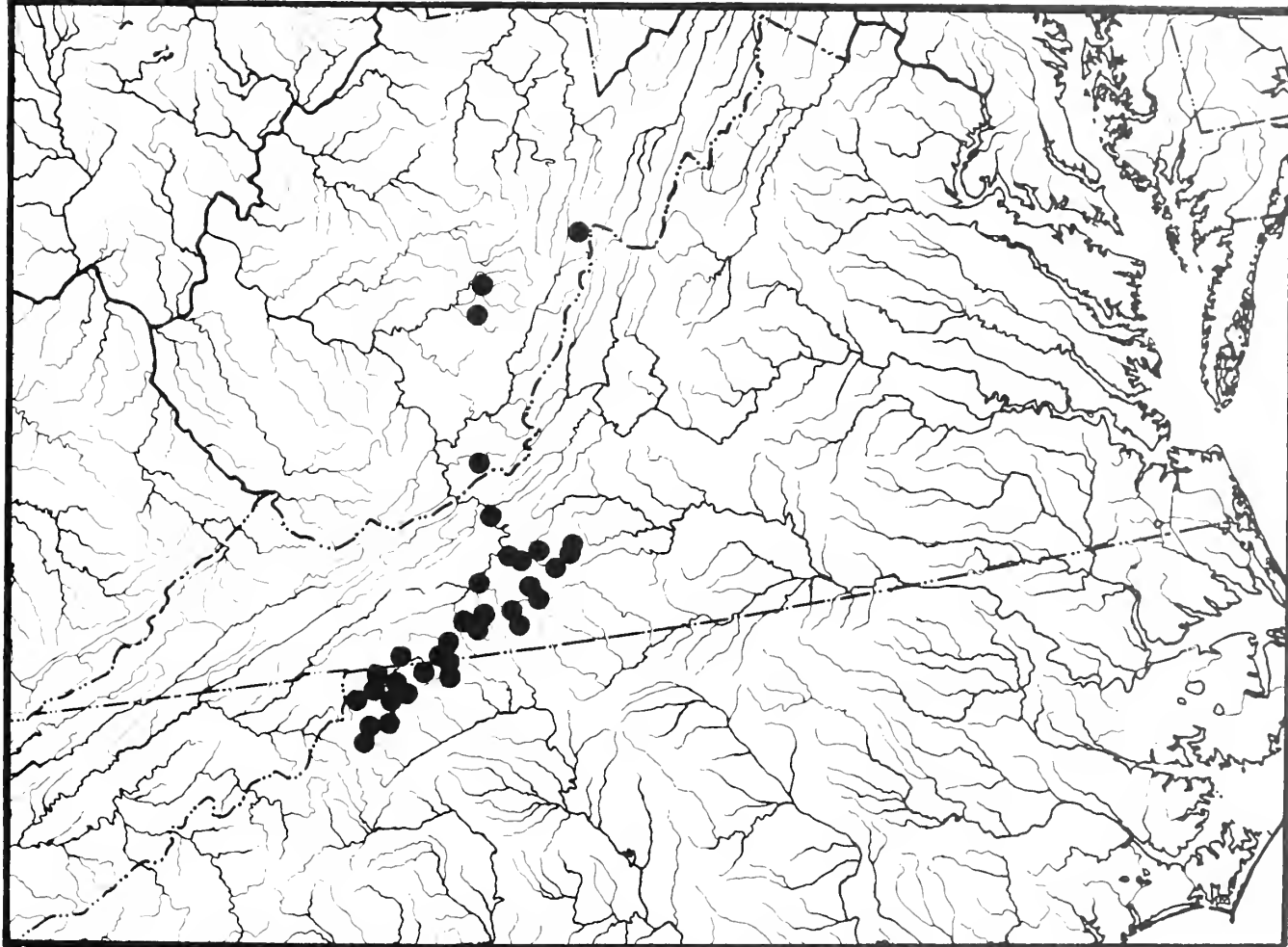
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: New River at Eggleston Springs, Giles Co., VA (Cope 1867. Proc. Acad. Nat. Sci. Phila. 19:95-97).

SYSTEMATICS: Monotypic species. Probably more closely related to the three fine-scaled species of *Phenacobius* than to its other congener, *P. mirabilis* (Minckley and Craddock 1962. Copeia :369-77).



WV: Greenbrier Co., Laurel Creek, 79 mm SL (NCSM).



Map modified from Hambrick et al. 1975

DISTRIBUTION AND HABITAT: Endemic to New (upper Kanawha) River drainage, NC, VA, and WV. Generally distributed only in upper section of drainage within Blue Ridge province (Hambrick et al. 1975. Copeia: 172-76). Single record for Ridge and Valley province of VA, near WV line, is of syntypes. Only five recent records for WV (Hocutt et al. 1978. J. Biogeogr. 5:59-80; Hocutt et al. 1979. Brimleyana 1:47-80; Hocutt and Stauffer unpubl.). Juveniles and adults typically occupy riffles and runs of gravel, rubble and boulder in cool to warm, medium to large streams. Generally uncommon.

ADULT SIZE: 50-80 mm SL.

BIOLOGY: Feeds on variety of immature benthic insects; tubificids and small snails also among gut contents (Hambrick et al. 1975). Spawns in late spring and/or early summer, based on gonadal and tubercle development.

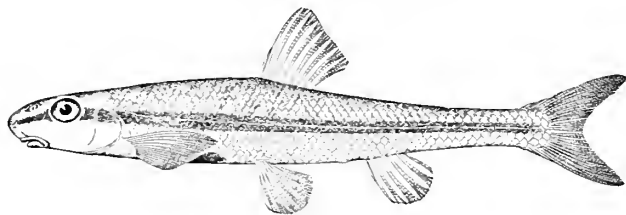
Compiler: R. E. Jenkins. March 1979.

Phenacobius uranops Cope
Stargazing minnow

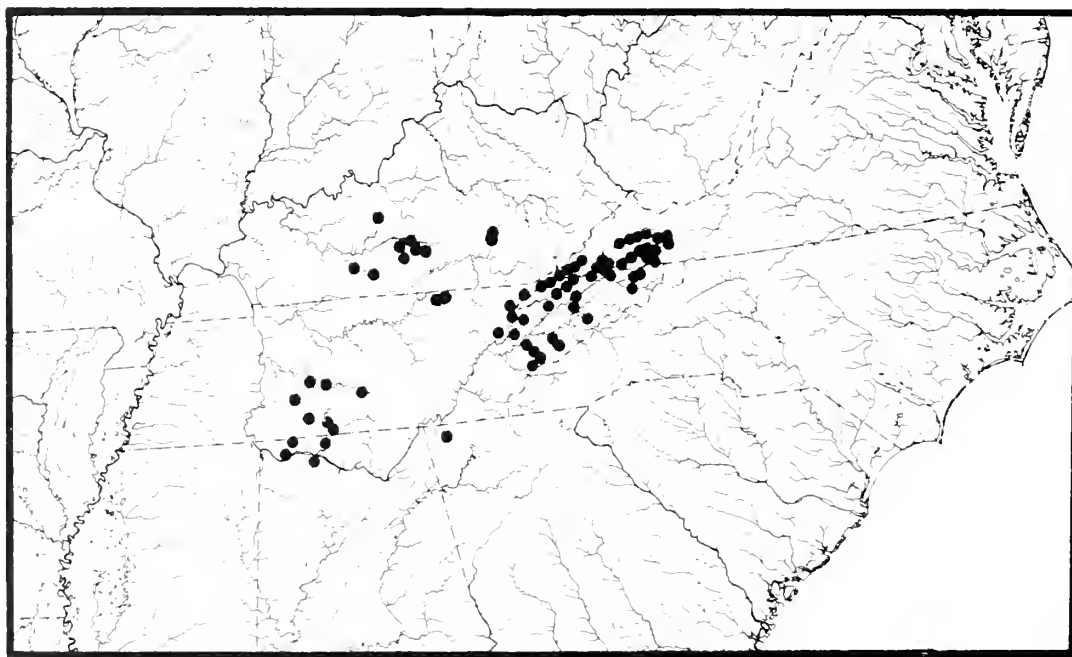
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: North Fork Holston River near Saltville, Smyth and/or Washington Co., VA (Cope 1867, Proc. Acad. Nat. Sci. Phila. 19:95-97; locality restricted by Cope 1868, J. Acad. Nat. Sci. Phila. 6:207-47).

SYSTEMATICS: No intra- or interdrainage variation mentioned by Minckley and Craddock (1962, Copeia:369-77). Probably most closely related to the other fine-scaled species of *Phenacobius*: *P. catostomus* and *P. crassilabrum*.



GA: Chickamauga Creek, Lee and Gordon's Mill (Jordan and Evermann 1900).



Map modified from Minckley and Craddock 1962

DISTRIBUTION AND HABITAT: Tennessee, Cumberland, and Green river drainages. Occurs widely in uplands of Tennessee drainage, AL, TN, and VA, avoiding higher gradients in Blue Ridge section of drainage in NC. Syntopic with *P. crassilabrum* in South Fork Holston system, VA and (prior to impoundment) TN. Only GA record, from Chickamauga River, dates from 1893 (Evermann and Hildebrand 1916, Bull. U. S. Bur. Fish. [1914] 34:431-51). Only recent Cumberland record from Rockcastle River in 19-

55. Generally distributed apparently only in upper Tennessee drainage, where it is common to uncommon. Inhabits rocky and, more frequently, gravelly runs and riffles in medium to large, warm, generally clear streams.
ADULT SIZE: 60-100 mm SL.

BIOLOGY: Poorly known. Based on tubercle development, apparently spawns in spring.

Compiler: R. E. Jenkins. February 1979.

Phoxinus cumberlandensis Starnes
and Starnes
Blackside dace

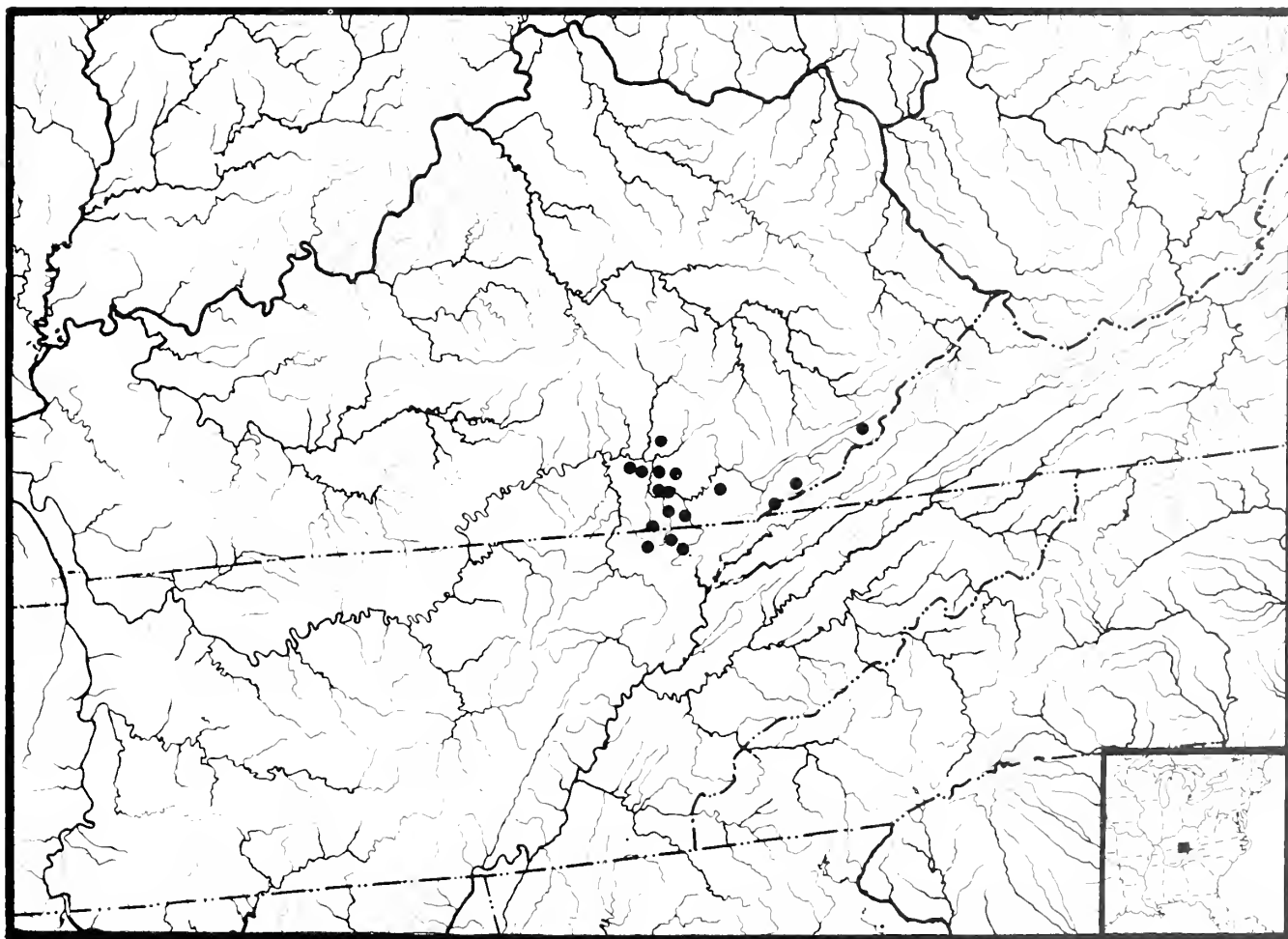
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Brownies Creek along route 987 at Cubage, Bell Co., KY (Starnes and Starnes 1978. Copeia: 508-16).

SYSTEMATICS: Well differentiated from other members of *Phoxinus*, but appears most closely related to allopatric *P. oreas*, based on morphological characters and coloration.



KY: Bell Co., Brownies Creek.
55 mm SL (Starnes and Starnes
1978).



DISTRIBUTION AND HABITAT: Confined to small tributaries of upper Cumberland above Cumberland Falls and a few km below, KY and TN. In shallow to moderately deep pools in association with considerable cover such as bedrock, rubble, undercut banks, or brush. Apparently extirpated from many former localities due to degradation from surface mining.

ADULT SIZE: 50-60 mm SL.

BIOLOGY: Spawns May and June. Preliminary diet analysis reveals considerable ingestion of detritus, diatoms, algae, and (seasonally) insects. Length classes indicate life-span of three to four years. Life history currently under investigation by compilers.

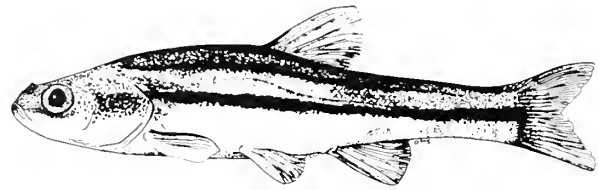
Compilers: W. C. Starnes and L. B. Starnes.
December 1978.

Phoxinus eos (Cope)
Northern redbelly dace

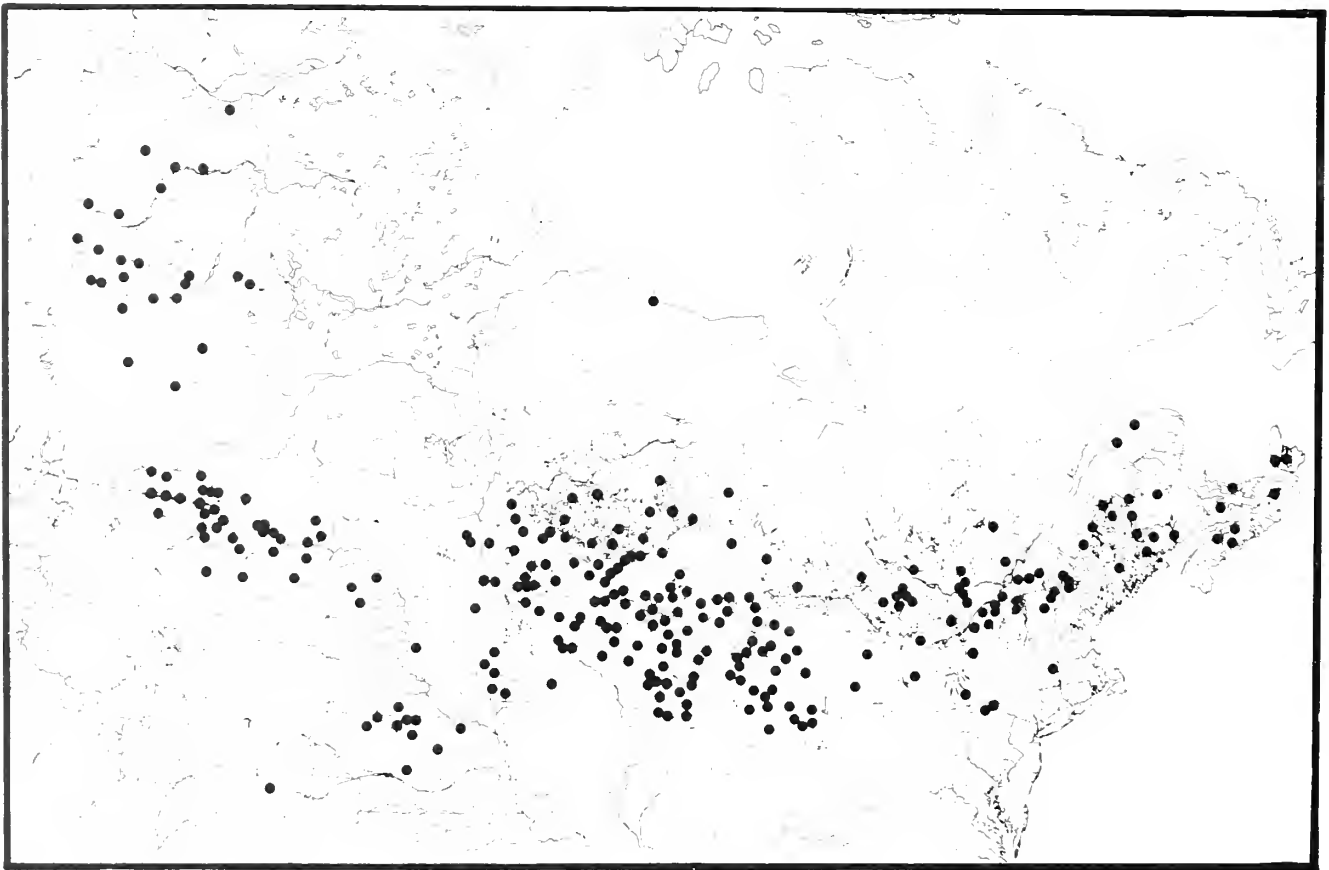
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Meshoppen Creek, Susquehanna Co., PA (Cope 1862. Proc. Acad. Nat. Sci. Phila. [1861] 13:522-24).

SYSTEMATICS: Genus *Chrosomus* recently synonymized with *Phoxinus* (see explanation under *P. neogaeus*). Often difficult to distinguish from *P. erythrogaster*. Phillips (1969. Copeia:501-09) published detailed morphological comparison based on MN specimens. New (1962. Copeia:147-52) and Stasiak (1977. Copeia:771-74) listed some morphological differences between *P. eos* and *P. neogaeus* and their hybrids.



MN: Clearwater Co., Itasca State Park, male, 50 mm SL (D. M. Sutherland).



DISTRIBUTION AND HABITAT: Boggy lakes, creeks, and ponds from NS, PE, and St. Lawrence and Atlantic drainages of New England, west to Peace-Mackenzie drainage in BC and NT and south to upper Missouri River drainage, Great Plains.

ADULT SIZE: 40-55 mm SL, 61 mm SL maximum.

BIOLOGY: Cooper (1935. Trans. Am. Fish. Soc. 65:132-42) and Hubbs and Cooper (1936. Cranbrook Inst. Sci. Bull. 8:1-95) studied reproductive behavior in MI. Scott and Crossman (1973. *Freshwater Fishes of Canada*) summarized general biology in Canada. Spawning occurs May to August, within mats of filamentous algae. Food consists of diatoms, algae, zooplankton, and aquatic insects. Age determinations made by Legendre (1970. Can. J. Zool. 48:1167-77).

Compiler: R. H. Stasiak. June 1978.

Phoxinus erythrogaster (Rafinesque)
Southern redbelly dace

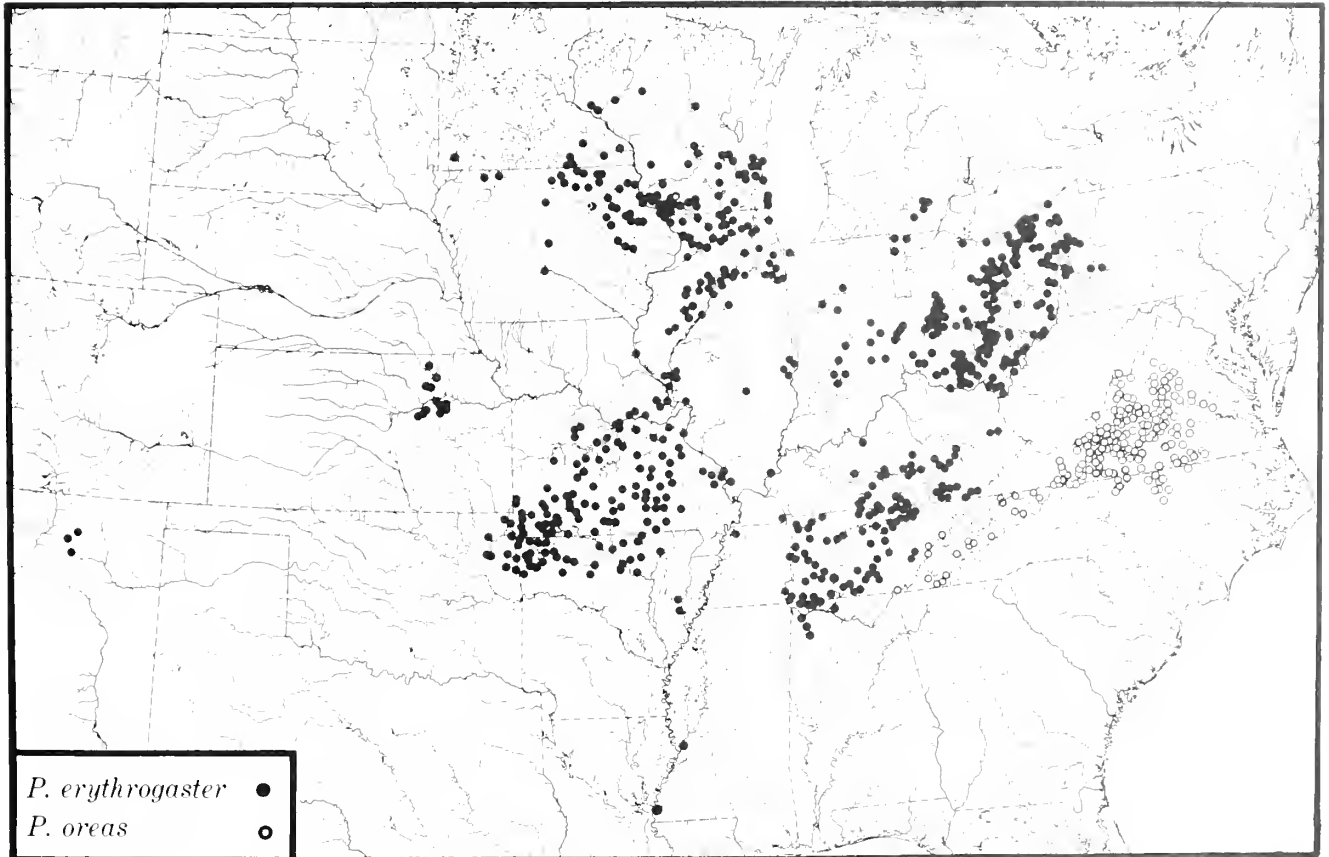
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: "Kentucky River" (possibly a small tributary), KY (Rafinesque 1820, *Ichthyologia Ohiensis*).

SYSTEMATICS: Based on morphology and coloration, appears most closely related to *P. eos*. Intraspecific variation analyzed on local and regional basis (Hill and Jenssen 1969, Southwest. Nat. 13:55-60; Phillips 1969, Copeia: 501-09) and found to be minimal; range-wide study not published.



MO: Miller Co., Big Tavern Creek, 58 mm SL (Mo. Dept. Cons.).



DISTRIBUTION AND HABITAT: Small upland streams from MN and western PA south to AR and AL. Within Mississippi Embayment, relict populations in isolated upland-like habitats along Crowleys Ridge (Fulmer and Harp 1977, Arkansas Acad. Sci. Proc. 31:42-45), along eastern rim of Mississippi floodplain in MS (Hemphill 1957, Copeia: 53; Cashner et al. 1979, Proc. Southeast. Fish. Counc. 3:1-4), and near Reelfoot Lake, TN. Extremely isolated populations of undetermined origin in headwaters of Arkansas River drainage in northeastern NM (Koster 1957, *Guide to the Fishes of New Mexico*). May be common in preferred habitat.

ADULT SIZE: 55-65 mm SL.

BIOLOGY: Spawns May-June in northern portions of range (Eddy and Underhill 1973, *Northern Fishes*); southern populations spawn April-June (Settles and Hoyt 1978, Am. Midl. Nat. 99:290-98). Fecundity estimates range widely, from less than 700 (Settles and Hoyt 1978) to 6,000-19,000 (Phillips 1969, Trans. Am. Fish. Soc. 98:524-26). Spawns in shallow gravel riffles, with two males often attending a single female (Smith 1908, Biol. Bull. 15:9-18). Lifespan three years (in KY), with sexual maturity reached during first year (Settles and Hoyt 1976, Trans. Ky. Acad. Sci. 37:1-10). Diet primarily detritus and surface slime, with associated algae and small invertebrates (Phillips 1969, Am. Midl. Nat. 82:99-109; Settles and Hoyt 1976).

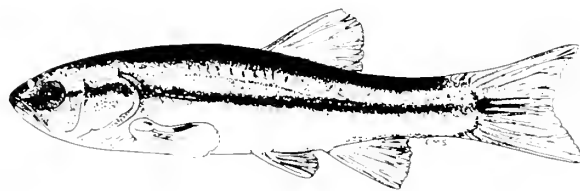
Compilers: W. C. Starnes and L. B. Starnes.
December 1979.

Phoxinus neogaeus Cope
Finescale dace

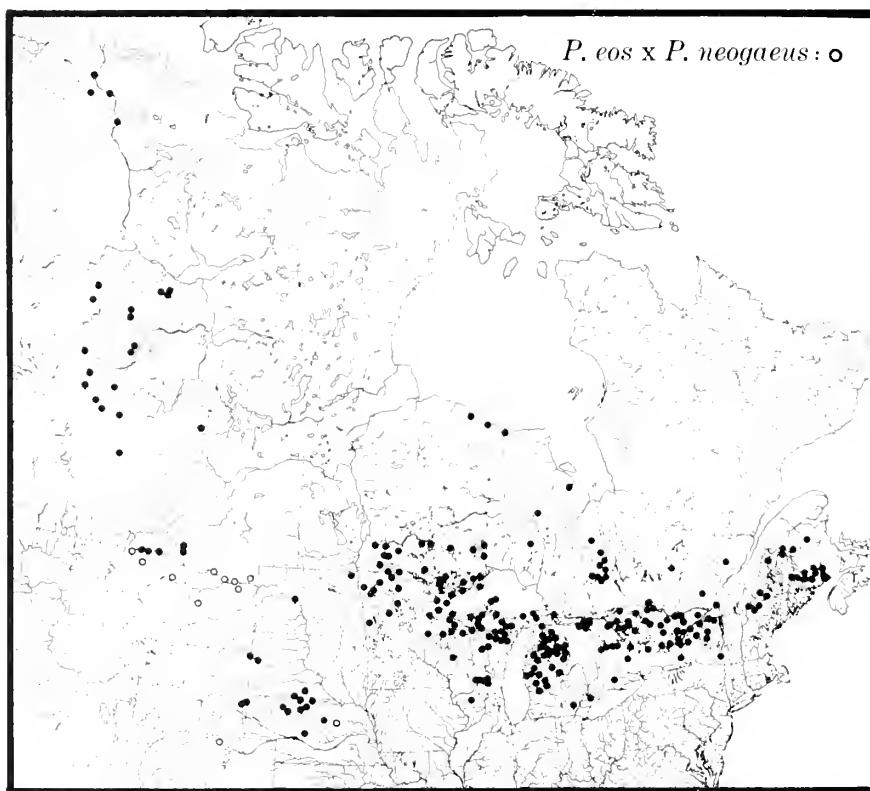
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Streams flowing into Lake Erie at New Hudson, Livingston Co., MI (Cope in Günther 1868. *Catalogue of the Fishes in the British Museum* 7:1-512).

SYSTEMATICS: Placed in monotypic genus *Pfrrille* by Jordan (1924, *Copeia*: 70-72). Since about 1951 has been included in genus *Chrosomus* by most authors. Probably represents link between Old World and New World minnows, as Banareescu (1964, *Fauna Republ. Pop. Romine. Pisces-Osteichthyes* 13: 1-959) considered *Chrosomus* a subgenus of Eurasian *Phoxinus* (as first reviser, *Phoxinus* was selected between these names of identical date). Recent data of Mahy (1972, *Am. Zool.* 12:728-29) and Coad (1975, Ph.D. diss., Univ. Ottawa) support synonymy.



MN: Clearwater Co., Itasca State Park, male, 65 mm SL (D. M. Sutherland).



DISTRIBUTION AND HABITAT: Prefers small boggy creeks and lakes; often common in beaver ponds. Widely distributed from Arctic Circle in Mackenzie River drainage in northwest to St. Lawrence and Atlantic drainages of NK, ME, NH, and NY to southeast. Occurs south to Great Lakes and upper Mississippi River basins, with relict populations in Sand Hills of NB and Black Hills of SD. Hybrid *P. eos* x *P. neogaeus* recorded in MT and CO (indicated by open circles on map). Hybrids also known from other portions of range.

ADULT SIZE: 55-65 mm SL, 90 mm SL maximum.

BIOLOGY: Scott and Crossman (1973, *Freshwater Fishes of Canada*) summarized general biology in Canada. Stasiak (1977, *Copeia*: 771-74; 1978, *Trans. Am. Fish. Soc.* 720-23) studied ecology and reproductive habits of a population in MN. Spawns late April through May (probably June in much of Canada) under logs and debris in ponds. Females live longer, grow larger than males. Adults feed primarily on insects and mollusks (snails and fingernail clams). Lethal temperatures tolerance studied by Tyler (1966, *Can. J. Zool.* 44:349-64).

Compiler: R. H. Stasiak, June 1978.

Phoxinus oreas (Cope)
Mountain redbelly dace

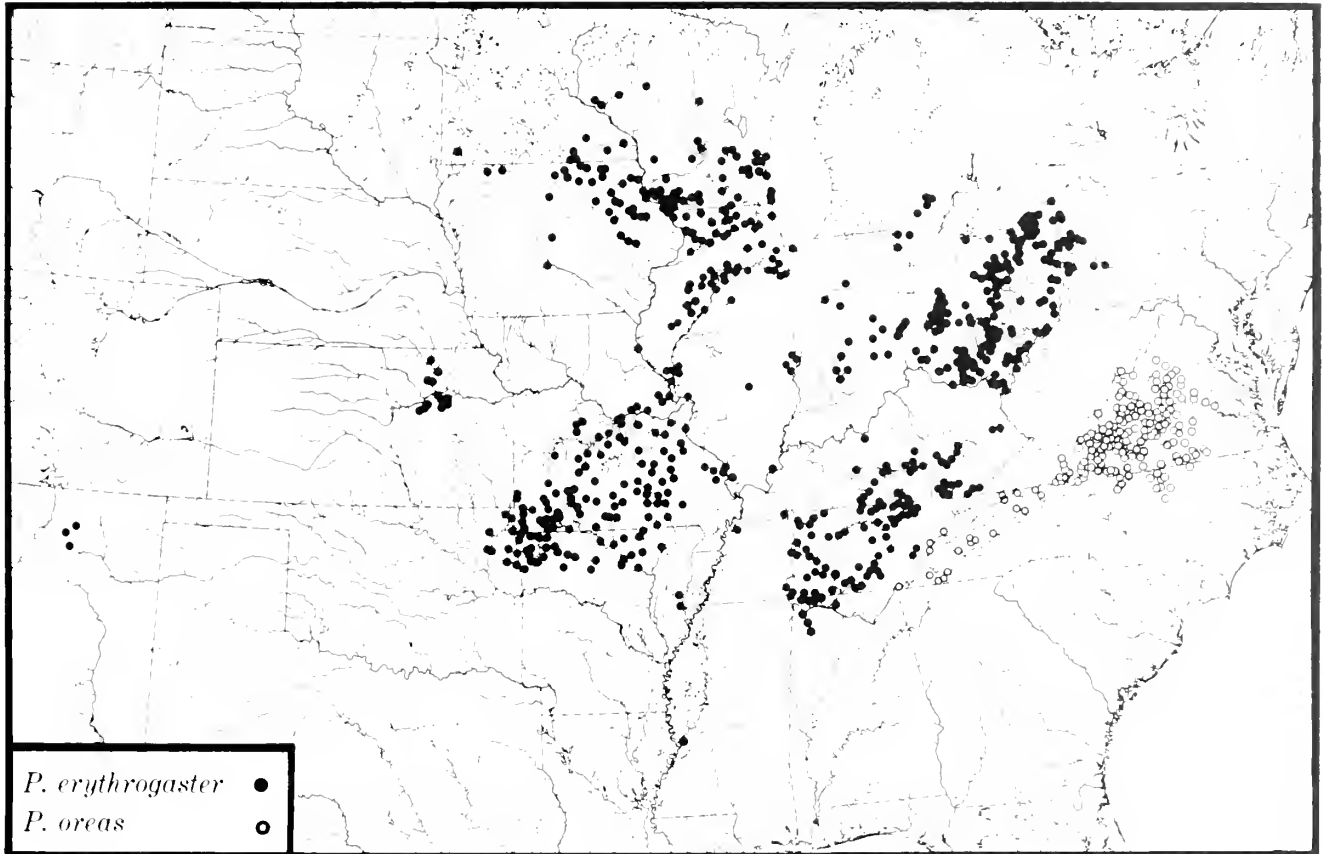
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Head of Roanoke River, Montgomery Co., VA (Cope 1868. J. Acad. Nat. Sci. Phila.:207-47).

SYSTEMATICS: Morphology and coloration suggest close relationship to *P. cumberlandensis* (Starnes and Starnes 1978. Copeia: 508-16). A distinctive subspecies, currently under study by the compilers and R. E. Jenkins, occurs in upper Tennessee drainage.



VA: Botetourt Co., Tinker Creek, 55 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Nominate subspecies in mountains and piedmont of central Atlantic slope from Shenandoah system (Potomac drainage), VA, south to Neuse drainage, NC, and in adjacent mountains of New (upper Kanawha) drainage, NC, VA, and, rarely, WV. Single recent report from upper Yadkin system (Peedee drainage), NC, probably based on introduction. Upper Tennessee drainage subspecies occupies Blue Ridge and Ridge and Valley, TN and VA. Nominate form typical of small, cool to warm, clear to often turbid, sandy to rocky streams, and generally common. Highly localized but sometimes common in upper Tennessee drainage, where appears restricted to very small streams.

ADULT SIZE: 50-60 mm SL.

BIOLOGY: Ornate species, observed spawning during spring and early summer in association with *Nocomis* nests (Raney 1947. Zoologica 32:125-32). Other aspects of life history and diet unpublished, but probably similar to *P. erythrogaster* and *P. cumberlandensis*.

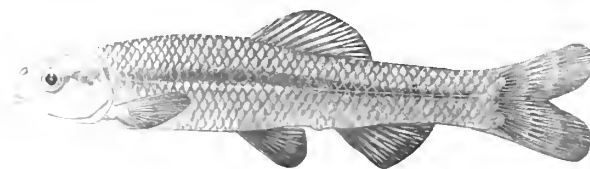
Compilers: W. C. Starnes and L. B. Starnes.
December 1978.

Pimephales notatus (Rafinesque)
Bluntnose minnow

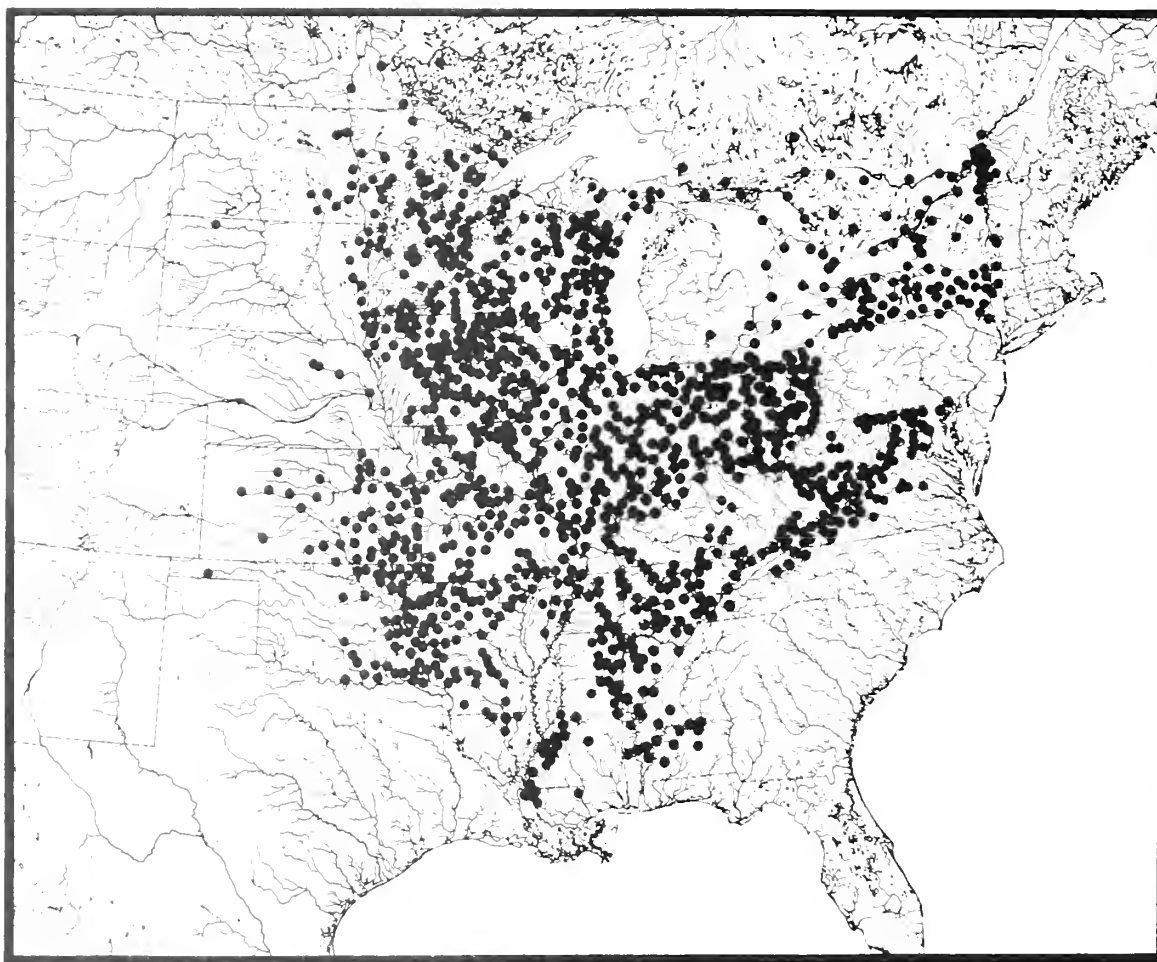
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Ohio River (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Morphologically most advanced member of genus (Hubbs and Black 1947. Misc. Pub. Mus. Zool. Univ. Mich. 66: 1-56). Formally included in monotypic genus *Hyborhynchus*.



MD: Frederick Co., Monacacy River, 68 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Native to central North America in Mississippi and Great Lakes basins from southern Canada to Gulf slope. Also on Atlantic slope from VA north to southern QU. Often transplanted as bait fish. Common in wide variety of habitats and tolerant of various pollutants.

ADULT SIZE: 40-90 mm TL, ca. 110 mm TL maximum.

BIOLOGY: Generalized bottom feeder on organic detritus, algae, and insect larvae; schools in midwater or near bottom. Protracted spawning season (May to August in ON; Toner 1943. M.A. thesis, Univ. Toronto), with males guarding eggs attached to underside of cover. May spawn several times per season. Mature at one to three years of age. Synopsis of life history studies available in Scott and Crossman (1973. *Freshwater Fishes of Canada*), Trautman (1957. *The Fishes of Ohio*) and other regional works.

Compilers: D. S. Lee and J. R. Shute. November 1978.

Pimephales promelas Rafinesque
Fathead minnow

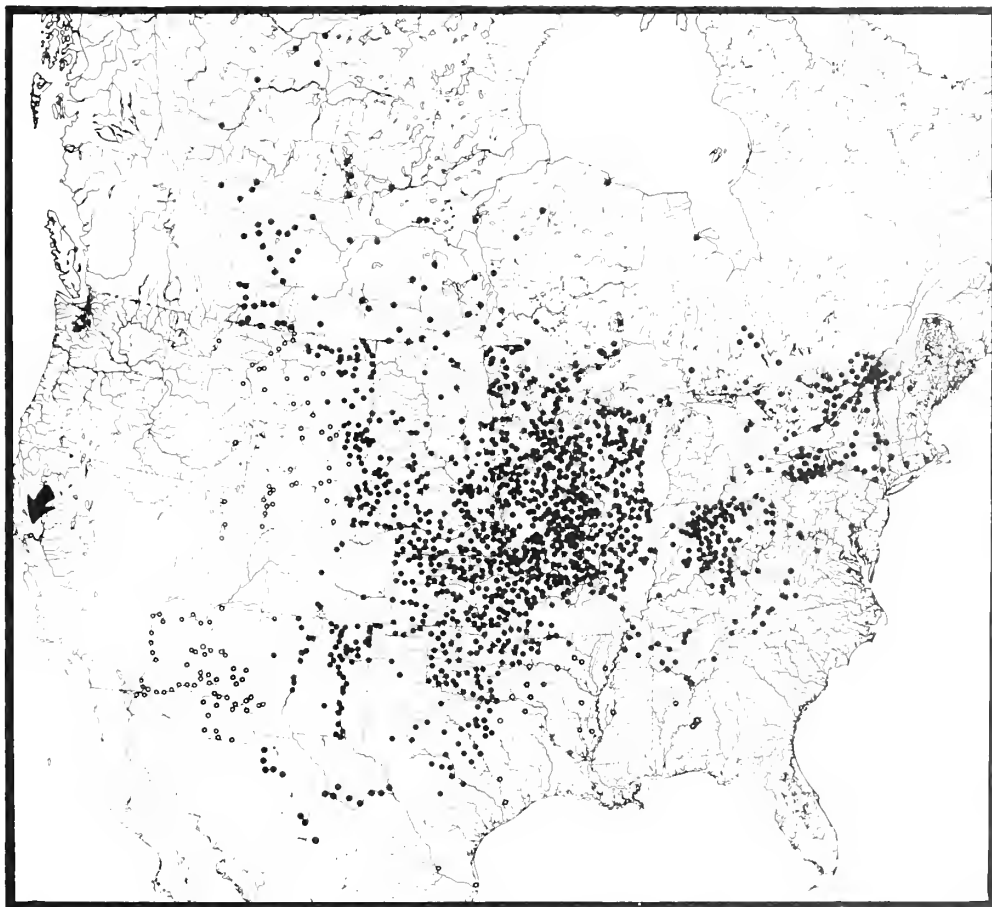
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Pond near Lexington, KY (Rafinesque 1820, *Ichthyologia Ohiensis*).

SYSTEMATICS: Several populations recognized as subspecies by Hubbs and Lagler (1949, Pap. Mich. Acad. Sci. Arts Lett. [1947] 33:73-133; 1958, *Fishes of the Great Lakes Region*), but validity questioned (Scott and Crossman 1973, *Freshwater Fishes of Canada*). Vandermeer (1966, *Copeia*:457-66) documented clinal variation. Specific name likely based on a species other than that to which it is now applied (possibly *Campostoma anomalum*) since fish is said to have "circular hard lips" and caught by hook and line (Rafinesque 1820).



MD: Cecil Co., Conowingo Reservoir, 55 mm SL (NCSM).



Open circles transplanted populations
Most Atlantic slope records probably transplanted populations

DISTRIBUTION AND HABITAT: Much of North America, from Chihuahua, Mexico, north to Great Slave Lake drainage, east to NK and west to AT. Popular bait fish, thus widely introduced throughout country. Common in wide range of habitats, from ponds to flowing streams. Tolerant of high temperature, turbidity and low oxygen.

ADULT SIZE: 43 - 102 mm TL.

BIOLOGY: Schools from midwater to near bottom. Coyle (1930, *Ohio J. Sci.* 30:23-35)

found algae to be main food, but also eats aquatic insect larvae. Most individuals mature during second year and species has prolonged spawning period. Eggs laid on underside of floating or suspended objects in quiet water. Male guards nest. Adapts well to pond culture. Life history summaries available in Scott and Crossman (1973), Pflieger (1975, *The Fishes of Missouri*) and other regional works.

Compilers: D. S. Lee and J. R. Shute.
November 1978.

Pimephales tenellus (Girard)
Slim minnow

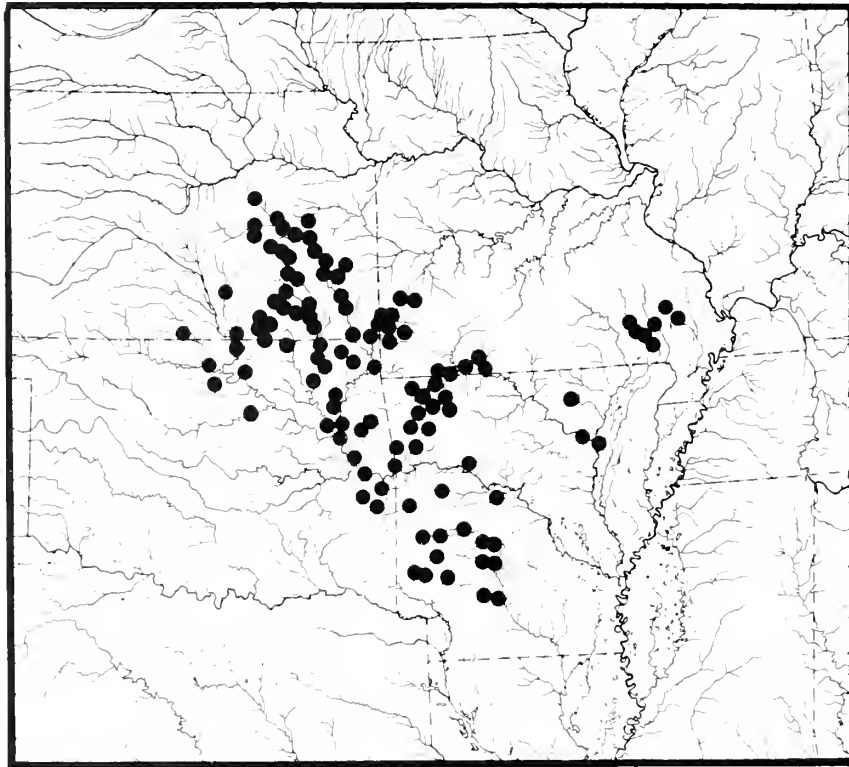
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Approximately 32 km w of Choctaw Agency, OK (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Formerly placed, with *P. vigilax*, in genus *Ceratichthys* (Hubbs and Black 1947. Misc. Publ. Mus. Zool. Univ. Mich. 66:1-56). Two subspecies were recognized by them, *P. t. tenellus* in eastern part of range, and *P. t. parviceps* to west. *Pimephales callarchus* (Hubbs and Black 1947), was synonymized with *P. tenellus* by Pflieger (1970. Copeia 355-56).



AR: Polk Co., Ouachita River,
42 mm SL (J. L. Harris) .



DISTRIBUTION AND HABITAT: Restricted to Ozarkian areas of MO, AR, OK, and KS, in Red and Arkansas River drainages and independent tributaries of Mississippi River. Common in small, quiet streams over sandy, gravelly or rocky bottoms.

ADULT SIZE: 38-64 mm TL, 69 mm TL maximum.

BIOLOGY: Habits and life history little known. Schools in midwater or near bottom. Cross (1967. Univ. Kans. Mus. Nat. Hist. Misc. Publ. 45:1-357.) collected breeding adults in KS from May to July. Spawning believed to occur in swift riffles.

Compiler: D. S. Lee. June 1978.

Pimephales vigilax (Baird and Girard)
Bullhead minnow

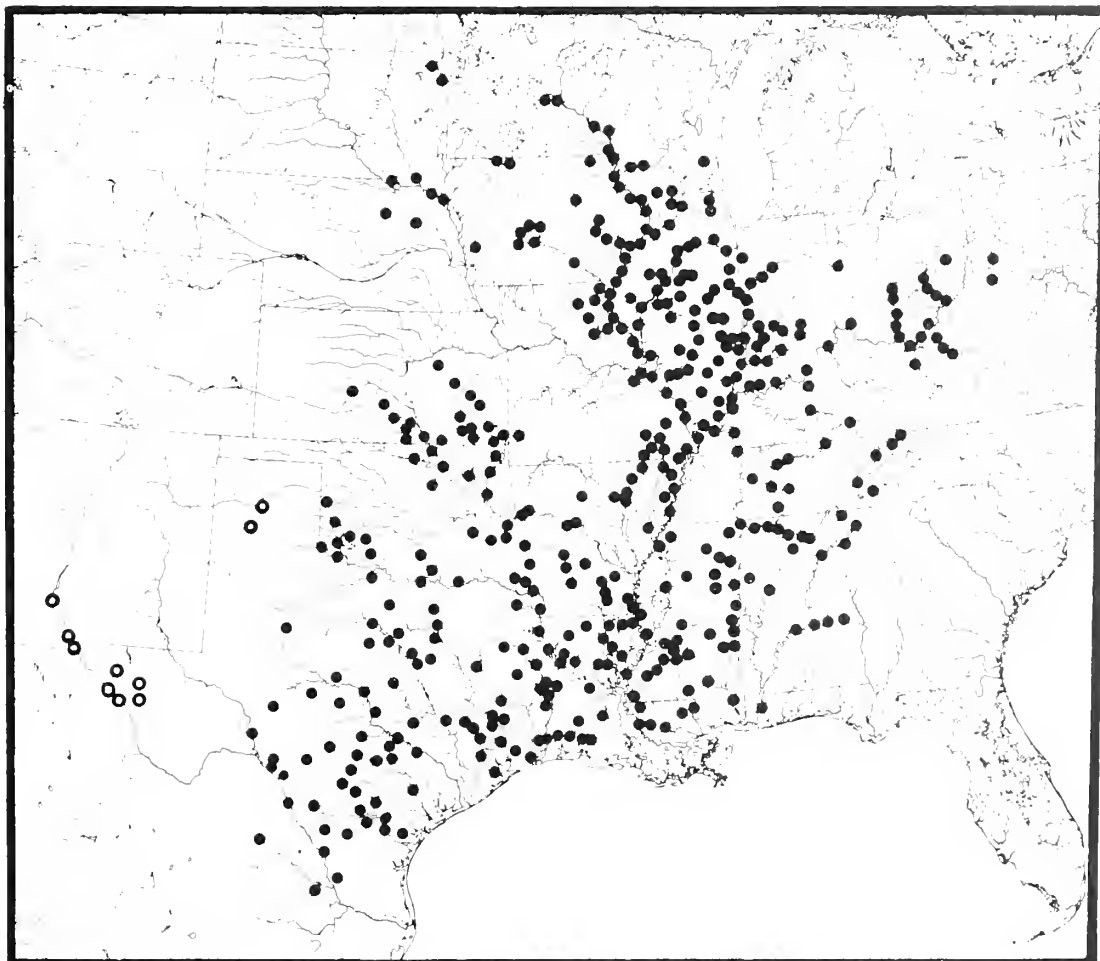
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Otter Creek, south-western OK (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. 6:390-91).

SYSTEMATICS: Hubbs and Black (1947. Misc. Publ. Mus. Zool. Univ. Mich. 66:1-56) revised species, which they included with *P. tenellus*, its closest relative, in genus *Ceraticthys*. They recognized two subspecies (typical form in TX, OK, and Mexico, and eastern *P. v. perspicuus*) not generally recognized today.



MO: Lewis Co., Mississippi
River at Canton, 42 mm SL
(Mo. Dept. Cons.).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Mississippi River basin from MN and SD south to Mexico, TX, LA, and MS, and east to GA and AL. Widespread in lowlands of basin and west through Gulf of Mexico drainages to Rio Grande. Upper Rio Grande and northern TX populations presumably introduced.

ADULT SIZE: 38-76 mm TL, 88.9 mm maximum

BIOLOGY: Feed mostly on bottom dwelling aquatic insects (Starrett 1950. Ecology 31: 216-33). Spawns late spring through early summer. Males excavate and guard nest cavities. Young reach lengths of 22.9 mm TL by end of summer (Pflieger, 1975. *The Fishes of Missouri*; Parker 1964. Southwest. Nat. 8:228-35).

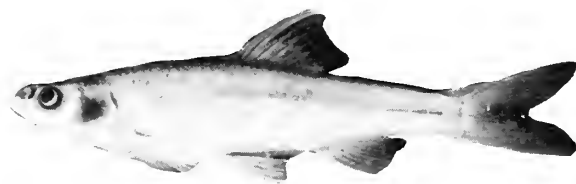
Compilers: D. S. Lee and S. T. Kucas. June 1978.

Plagopterus argentissimus Cope
Woundfin

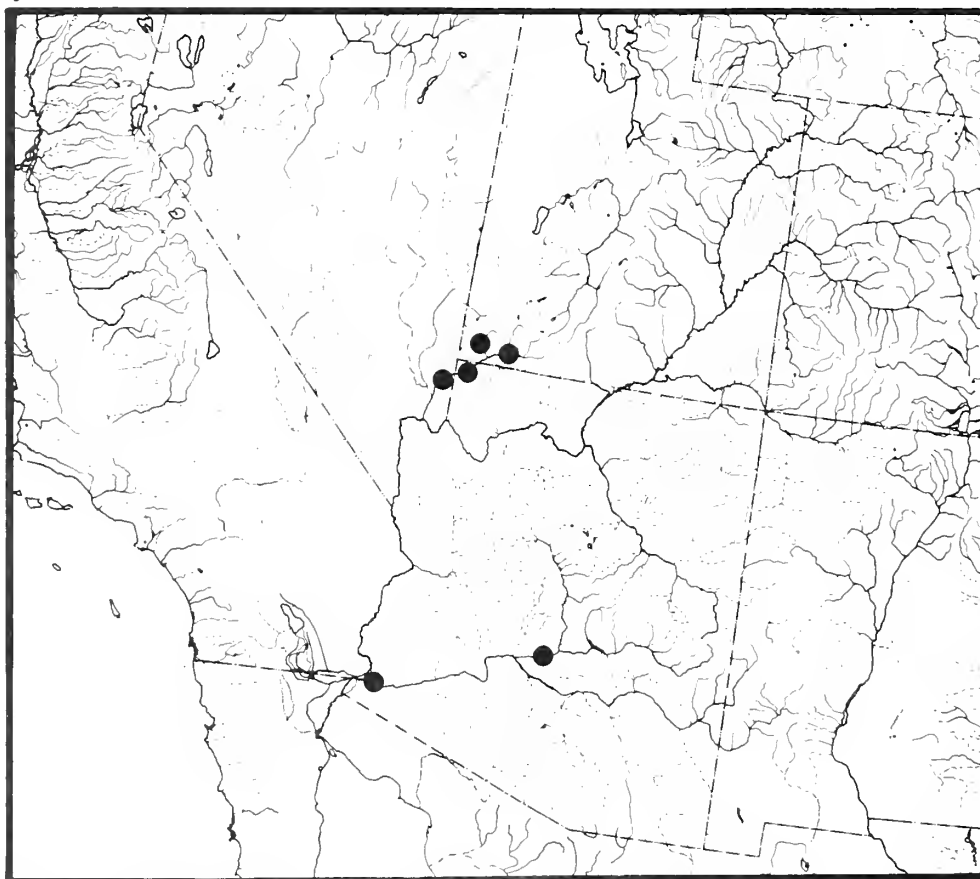
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: San Luis Valley, w CO (Cope 1874. Proc. Am. Philos. Soc. 14:129-39). Type locality in error since species does not occur outside lower Colorado River basin. Miller and Hubbs (1960. Misc. Publ. Mus. Zool. Univ. Mich. 115:1-39) believe type locality to be Virgin River, Washington Co., sw UT.

SYSTEMATICS: Miller and Hubbs (1960) reviewed tribe Plagopterini. They considered *Plagopterus* the most advanced genus among three represented, and that it and *Meda* were most closely related. Uyeno and Miller (1973. Copeia: 776-82) reached same conclusions based upon karyotypes, as did Coad (1976. Ph.D. diss., Univ. Ottawa) based on study of 28 characters.



AZ: Mohave Co., Virgin River
at Littlefield, 74 mm SL
(W. L. Minckley).



DISTRIBUTION AND HABITAT: Tributaries of lower Colorado River drainage (Virgin, Gila, and Salt rivers) in AZ, NV, and UT. One record from Moapa River, NV (Deacon and Bradley 1972. Trans. Am. Fish. Soc. 101: 408-19). Attempted introductions into Paria, Hassayampa, and Verde rivers, and Sycamore Creek (Agua Fria River drainage), AZ, unsuccessful. Extirpated from all areas except Virgin River. Meek's (1904. Publ. Field Columb. Mus. 5:1-252) record for Mexico presumably based upon proximity in AZ (Miller 1976. Fieldiana 69:1-31). Occupies main channel of seasonally swift, highly tur-

bid, and extremely warm streams, with sandy, constantly shifting bottoms.

ADULT SIZE: Rarely exceeds 75 mm.

BIOLOGY: Reproduction occurs in summer, on basis of occurrence of young in collections. Maturation appears to occur in second summer, and few if any individuals live more than four years. Appears to undertake relatively long migrations within present habitat. Minckley (1973. *Fishes of Arizona*) and Cross (1975. M.S. thesis, Univ. Nevada, Las Vegas) summarized information.

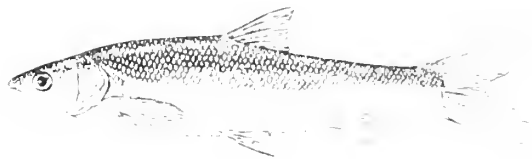
Compiler: W. L. Minckley. July 1978.

Pogonichthys ciscoides Hopkirk
Clear Lake splittail

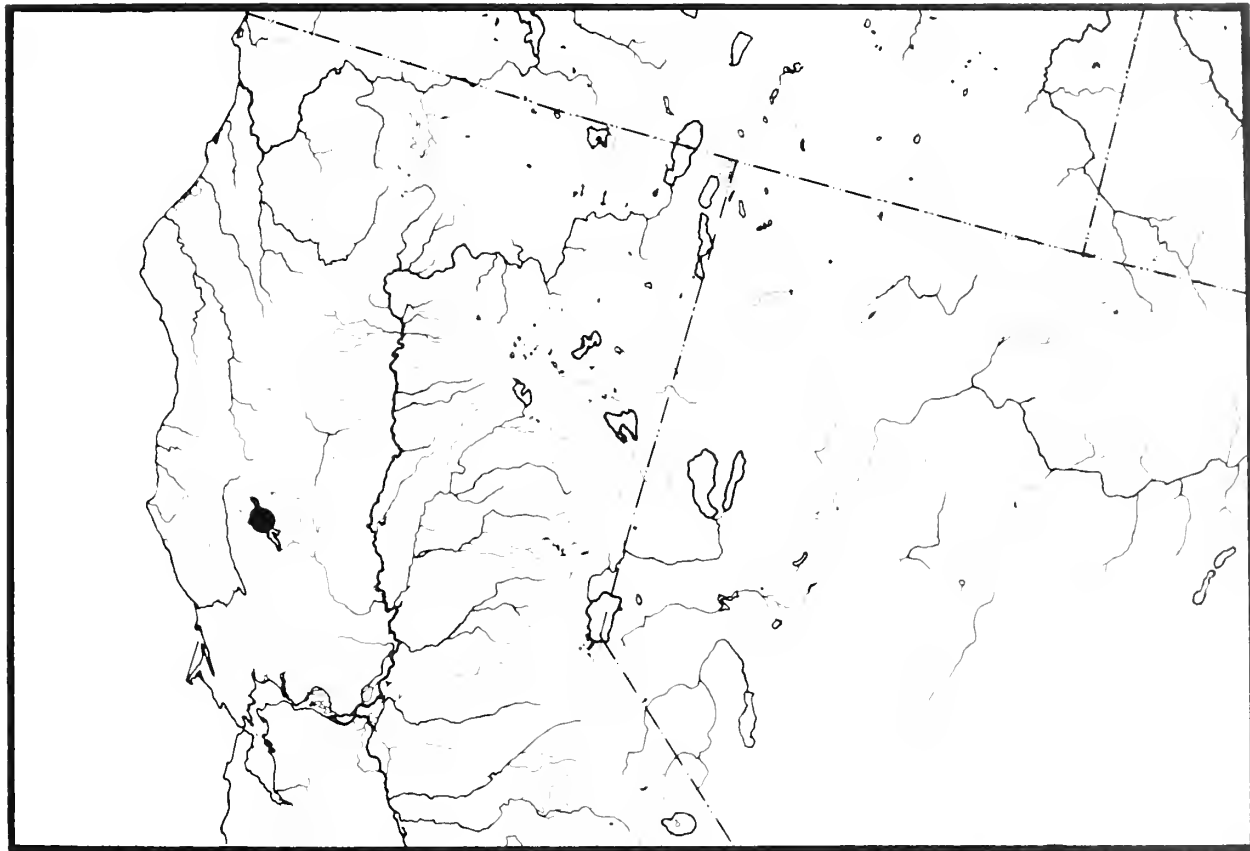
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Clear Lake, Lake Co., CA (Hopkirk 1973. Univ. Calif. Publ. Zool. 96:1-160).

SYSTEMATICS: Lacustrine derivative of *P. macrolepidotus*. Validity of this species questioned by Hubbs (1974. Copeia:808-09).



CA: Lake Co., Clear Lake, 21 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Once probably the most abundant species in Clear Lake but now apparently extinct. Known only from Clear Lake where last specimens were collected in 1970. Spawned in streams tributary to the lake.

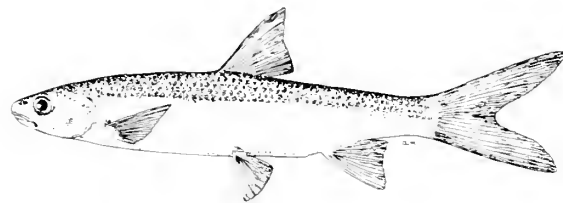
ADULT SIZE: 200-300 mm SL.

BIOLOGY: Pelagic planktivore, littoral when young. Known information summarized by Moyle (1976. *Inland Fishes of California*).

Compiler: P. B. Moyle. July 1978.

***Pogonichthys macrolepidotus* (Ayres)**
Splittail

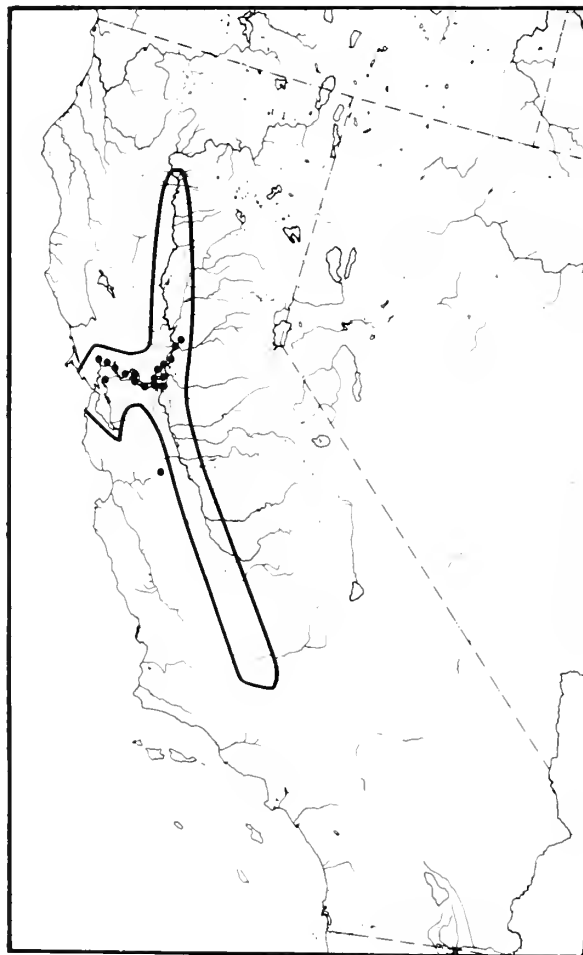
Order Cypriniformes
Family Cyprinidae



TYPE LOCALITY: San Francisco Market, but probably caught in Sacramento River or its estuary, CA (Ayres 1854. Daily Placer Times and Transcript, May 30; repeated 1854 in Proc. Calif. Acad. Sci. 1:18).

SYSTEMATICS: See *P. ciscoides*. The genus is very different from other CA endemic cyprinids (Avisé and Ayala 1976. Evolution 30:46-58).

CA: Sacramento-San Joaquin Delta, 19 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Formerly distributed in lakes and rivers of floor of great Central Valley, CA, but now confined to Sacramento-San Joaquin Delta region and lower Sacramento River, up to Red Bluff Diversion Dam. Former range outlined; dots indicate recent records only.

BIOLOGY: Benthic invertebrate feeder. Some information on life history in Moyle (1976. *Inland Fishes of California*). Life history studied by Caywood (1976. M.S. thesis, California State Univ., Sacramento).

ADULT SIZE: 200-400 mm SL.

Compiler: P. B. Moyle. July 1978

***Ptychocheilus grandis* (Ayres)**
Sacramento squawfish

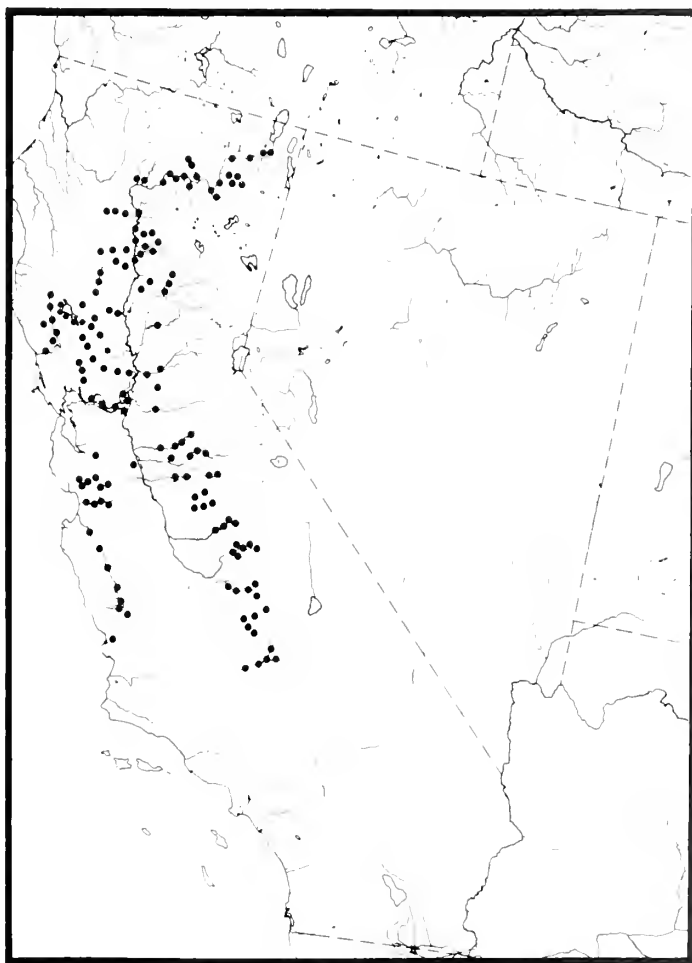
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: San Francisco Market, but fish probably from lower Sacramento River, CA (Ayres 1854, Daily Placer Times and Transcript, May 30. Repeated 1857 in Proc. Calif. Acad. Sci. [1854-57] 1:3-22).



SYSTEMATICS: Closely related to *P. umpqua* of Umpqua River, OR, and *P. oregonensis* of Columbia River drainage.

CA: Modoc Co., Putah Creek, juvenile, 10 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Larger and clearer intermittent and permanent streams (with summer temperatures in excess of 15°C) of Sacramento-San Joaquin drainage, CA, including Pajaro and Salinas rivers, Russian River, Pit River, and streams of Clear Lake drainage.

BIOLOGY: Piscivorous when larger than 150 mm SL. Life history (Moyle 1976, *Inland Fishes of California*) similar to *P. oregonensis*. Dettman and Li (in press, J. Fish. Res. Board Can.) indicate that under natural conditions it has little impact on trout populations.

ADULT SIZE: 200-600 mm SL, 1150 mm SL maximum.

Compiler: P. B. Moyle. July 1978.

Ptychocheilus lucius Girard
Colorado squawfish

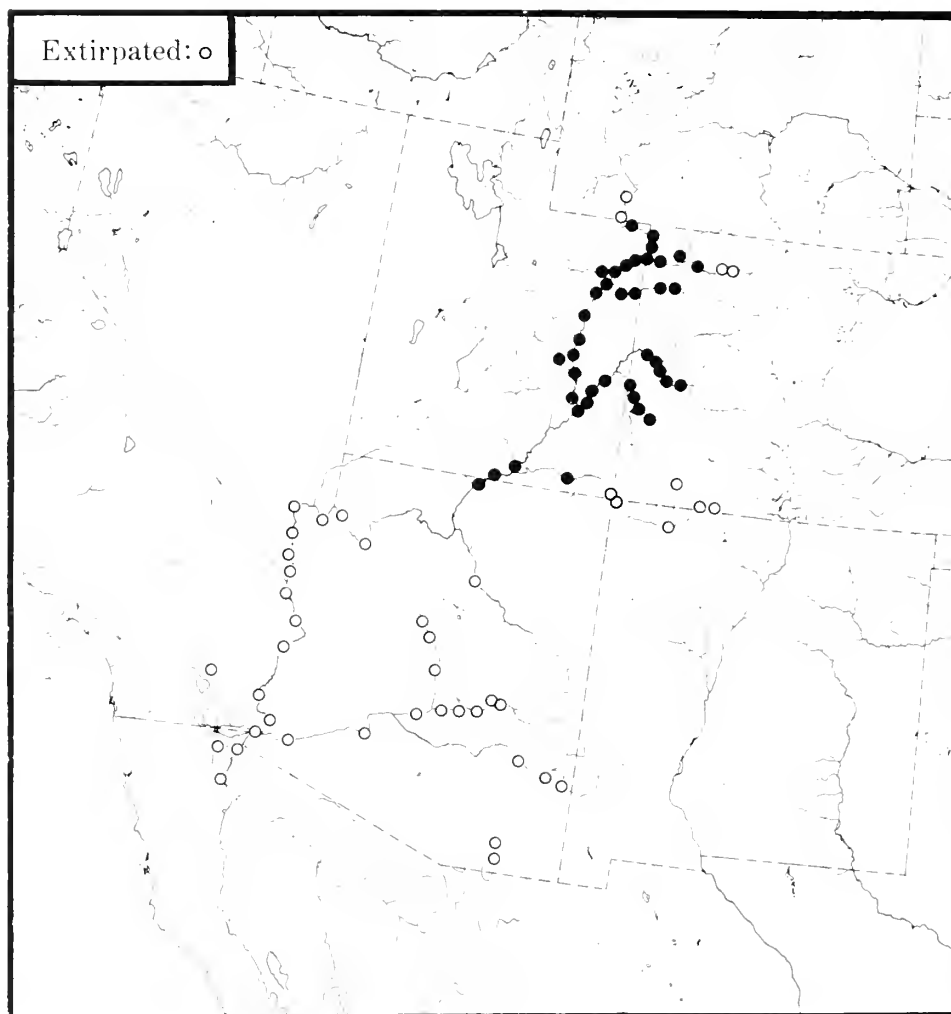
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Colorado River (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: No subspecies reported. *Ptychocheilus grandis*, of Sacramento River system, is closest relative.



WY: Green River, 35 cm SL
(Moyle 1976).



DISTRIBUTION AND HABITAT: Restricted to large rivers of Colorado River basin. Present distribution drastically reduced from original. Young prefer small, quiet backwaters, adults generally use eddies, runs, or backwaters.

BIOLOGY: Little known. Adults piscivorous. Once grew to 36-45 kg and is North America's largest minnow. Vanicek and Kramer (1969. Trans. Am. Fish. Soc. 98:193-208) reported on age, growth, food habits, and spawning times in UT.

ADULT SIZE: 450-600 mm TL, formerly to 1,800 mm.

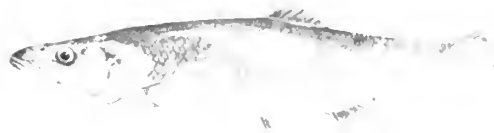
Compiler: P. B. Holden. September 1978.

Ptychocheilus oregonensis
(Richardson)
Northern squawfish

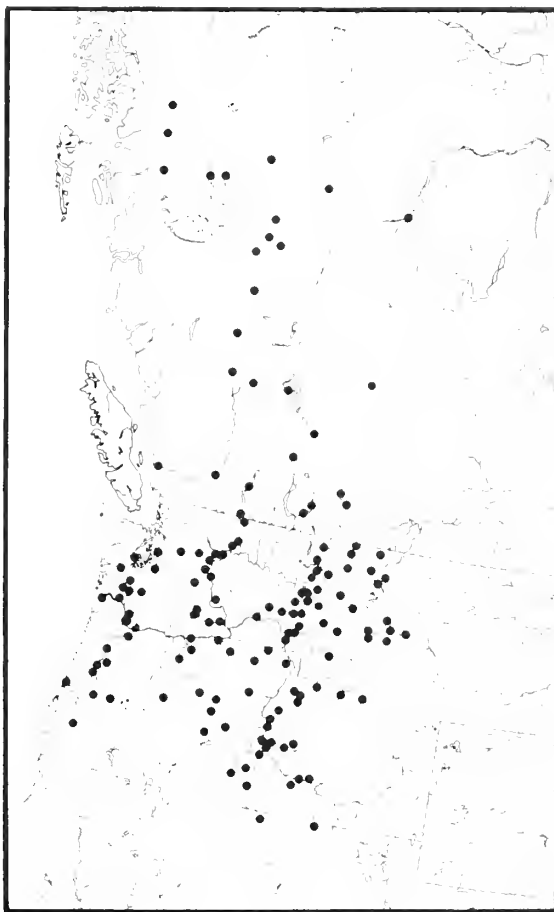
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Columbia River
(Richardson 1836. *Fauna Boreali-Americana*).

SYSTEMATICS: Stable species with only one synonym (La Rivers 1962. *Fishes and Fisheries of Nevada*). Most closely related to *P. umpqua* of Umpqua River drainage, OR.



(NMC)



DISTRIBUTION AND HABITAT: Abundant in rivers and lakes of Pacific Northwest from OR to Nass River, BC, including Columbia River drainage of OR, ID, and western MT and Harney Basin of eastern OR. Occurs east of Continental Divide only in Peace River, BC (Scott and Crossman 1973. *Freshwater Fishes of Canada*).

ADULT SIZE: 210-300 mm SL.

BIOLOGY: Predaceous species; food habits studied by Clemens et al. (1939. Fish. Res. Board Can. Bull. 56:1-70), Godfrey (1955. J. Fish. Res. Board Can. 12:499-542), Thompson (1959. U.S. Fish Wildl. Serv. Fish. Bull. 60:43-58), Hill (1962. Proc. Mont. Acad.

Sci. 22:27-44), and Falter (1969. M.S. thesis, Univ. Idaho). Ecology studied by Jeppson and Platts (1959. Trans. Am. Fish. Soc. 88: 197-202), Rahrer (1963. Proc. Mont. Acad. Sci. 23:144-156), and Reid (1971. M.S. Thesis, Univ. Idaho). Patten and Rodman (1969. Trans. Am. Fish. Soc. 98:108-11) observed reproductive behavior in a reservoir. Work has been done on development and use of selective pesticide to control this species, considered a nuisance by some in parts of range (MacPhee and Ruelle 1969. Trans. Am. Fish. Soc. 98:676-84; MacPhee 1969. Proc. 49th Conf. West. Assoc. State Game Fish Comm.:209-18).

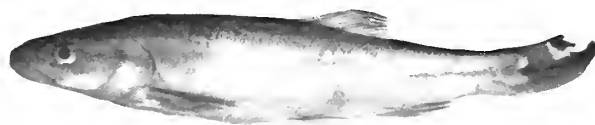
Compiler: R. L. Wallace. June 1978.

Ptychocheilus umpquae Snyder
Umpqua squawfish

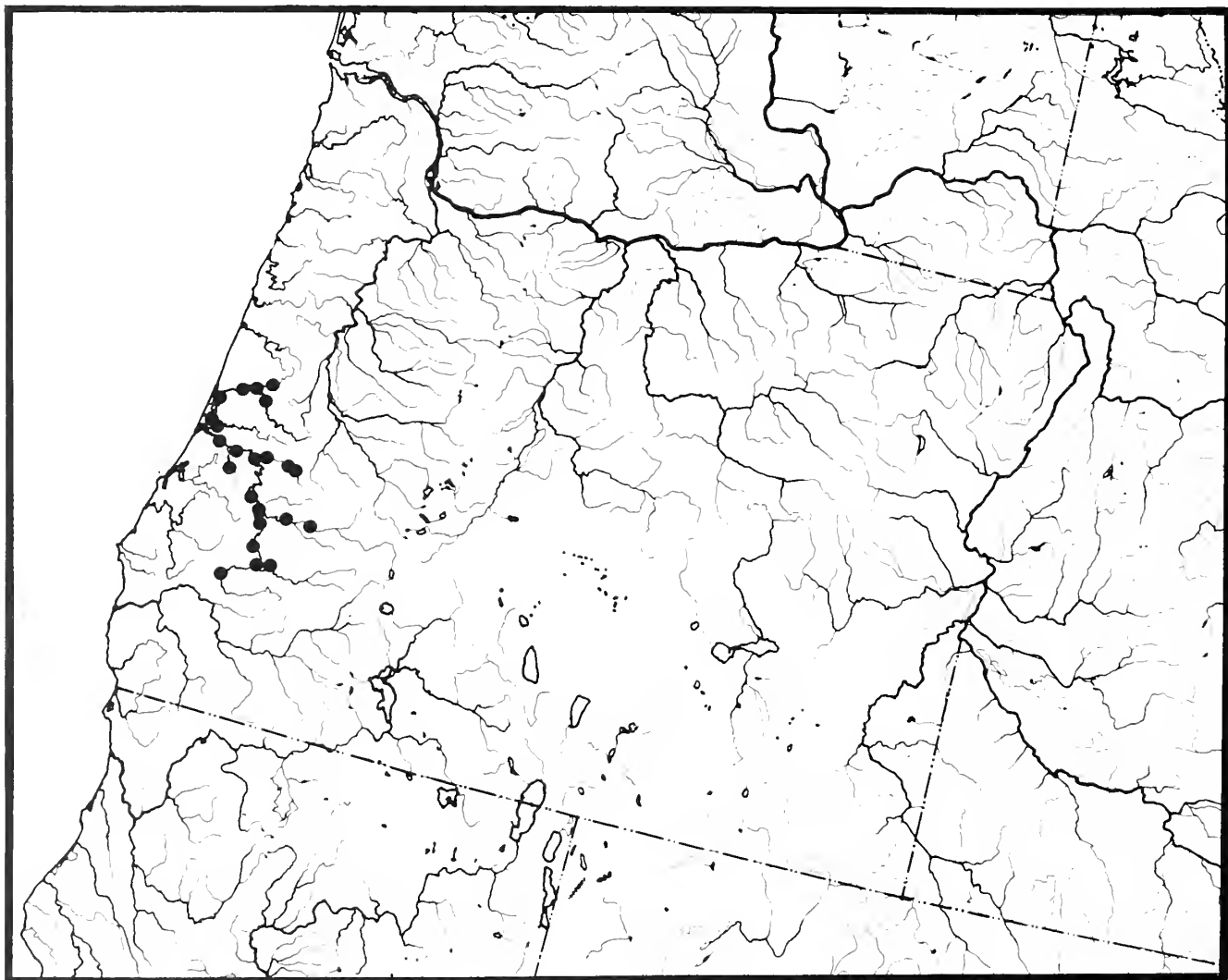
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Callapooia Creek, Oakland, Douglas Co., OR (Snyder 1908. Bull. U.S. Bur. Fish. [1907] 27:153-89).

SYSTEMATICS: Closely related to *P. oregonensis*, from which it apparently differs only in having smaller scales.



OR: Siuslaw River, 174 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Siuslaw and Umpqua rivers, Siltcoos, Woahink and Tahkenitch lakes, OR. Mainly in slow to moderate current, at depths usually greater than 1 m.

BIOLOGY: Little specific information available, but presumed to be similar to *P. oregonensis*. Spawns in late spring; young reach 40-60 mm SL in first year. Diet of adults includes fish and crayfish.

ADULT SIZE: 250-370 mm SL.

Compiler: C. E. Bond. June 1979.

Relictus solitarius Hubbs and Miller
Relict dace

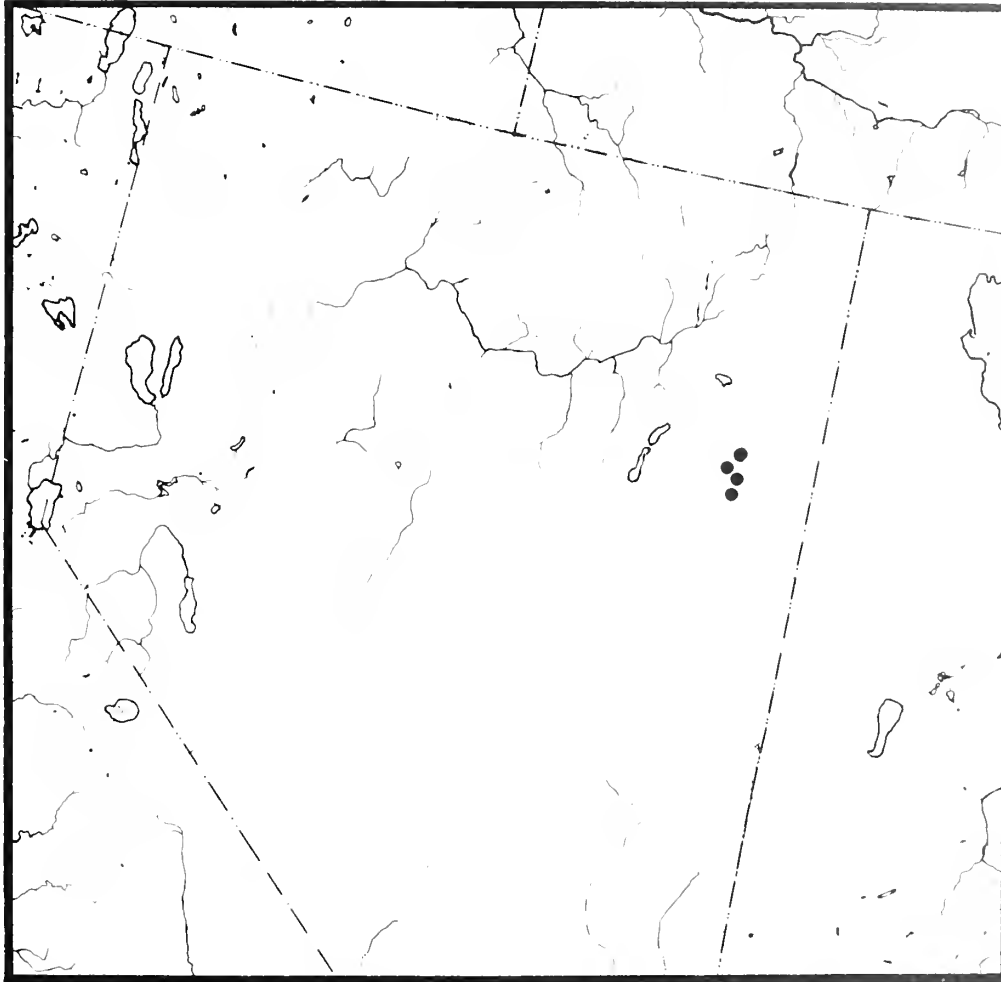
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Kirkpatrick Ranch, east side of Butte Valley, east part of T29N, R62E, 21 km nw of Currie, Lake Franklin drainage, Elko Co., NV (Hubbs and Miller 1972. Trans. San Diego Soc. Nat. Hist. 17:101-06).

SYSTEMATICS: Monotypic relict genus, probably most closely related to *Gila* and *Rhinichthys* (Hubbs et al. 1974. Mem. Calif. Acad. Sci. 7:1-259).



Paratype, female, 89.8 mm SL
(Hubbs et al. 1974).



DISTRIBUTION AND HABITAT: Endemic to ancient lakes of northeast NV, in drainage basins of pluvial lakes: Lake Franklin and tributary Lake Gale; Lake Waring and tributary Lake Steptoe; Lake Spring, where most likely introduced. Also may at one time have been stocked in a UT spring. In isolated springs and spring-fed streams with substrates of mud or stone. Springs vary from having no vegetation to being choked with mosses and algae. Tends to concentrate in pools, particularly well vegetated ones and where banks are undercut. Sometimes abundant.

ADULT SIZE: 30-100 mm SL, 114 mm SL maximum.

BIOLOGY: Secretive species, rapidly taking cover in soft bottom or vegetation. Typically midwater swimmer. Prefers cool to moderate temperatures, not very cold waters. Females attain greater size than males. Both sexes spawn first as yearlings, and spawning apparently prolonged, at least from late June to mid-September (Hubbs et al. 1974).

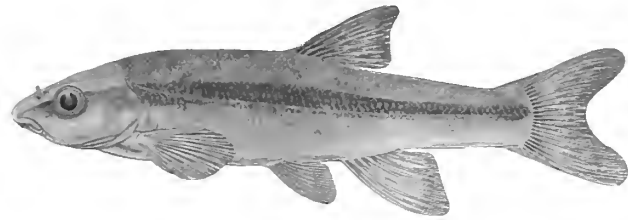
Compiler: S. P. Platania. June 1978.

Rhinichthys atratulus (Hermann)
Blacknose dace

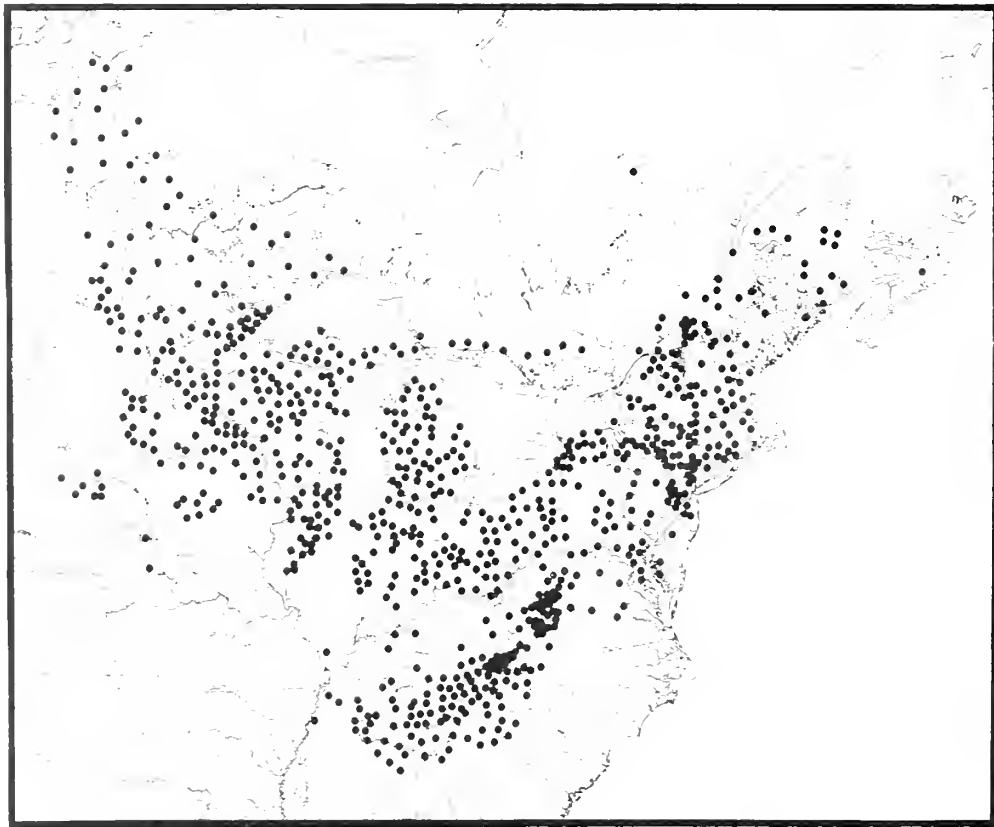
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: "North America"
(Hermann 1804. *Observations Zoologicae*,
quibus novae complures, aliaeque anamali
species describuntur et illustrantur 31: 1-332).

SYSTEMATICS: Three subspecies distributed about as follows: *R. a. atratulus* on Atlantic slope; *R. a. meleagris* in central and northern interior; and *R. a. obtusus* (including nominal form *sinus*) from lower Ohio basin to upper Mobile drainage (Hubbs 1936. *Copeia*: 124-25; Matthews et al. ms). Matthews et al. (1979. Abstr. 59th Ann. ASIH meetings) discussed intergradation between *R. a. atratulus* and *R. a. obtusus* in James River drainage, VA.



MD: Charles Co., Zekiah
Swamp, 51 mm SL (NCSM).



DISTRIBUTION AND HABITAT: From NS to MB, south in Mississippi and lower Missouri drainages to GA and AL. On Atlantic coast, ranges south from NS to SC and GA. Typically in small, usually cool, gravelly or rocky streams of high to moderate gradient, where generally found in pools and slower runs. Ubiquitous; common in many areas.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Traver (1929. *J. Elisha Mitchell Sci. Soc.* 45:101-29), Noble (1965. M.S. thesis, Iowa State Univ.), Scott and Crossman (1973.

Freshwater Fishes of Canada) and Bragg (1978. M.S. thesis, Univ. Nebraska at Omaha) studied life history, distribution, and ecology. Gee (1970. *J. Fish Res. Board Can.* 27:1855-59) investigated buoyancy. Bartnik (1970. *J. Fish Res. Board Can.* 27:2125-41) studied reproductive isolation between blacknose and longnose daces. Tarter (1970. *Am. Midl. Nat.* 83:134-59) studied feeding habits. Raney (1940. *Am. Midl. Nat.* 23:399-403), Schwartz (1958. *Copeia*: 141-43), and Phillips (1967. *J. Minn. Acad. Sci.* 34:11-13) studied reproductive habits.

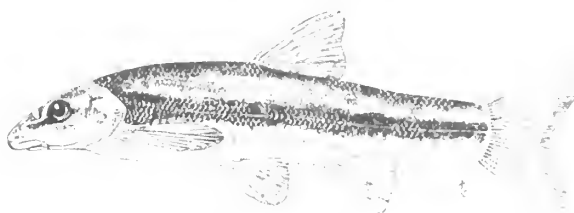
Compiler: R. J. Bragg, May 1978.

Rhinichthys cataractae
(Valenciennes)
Longnose dace

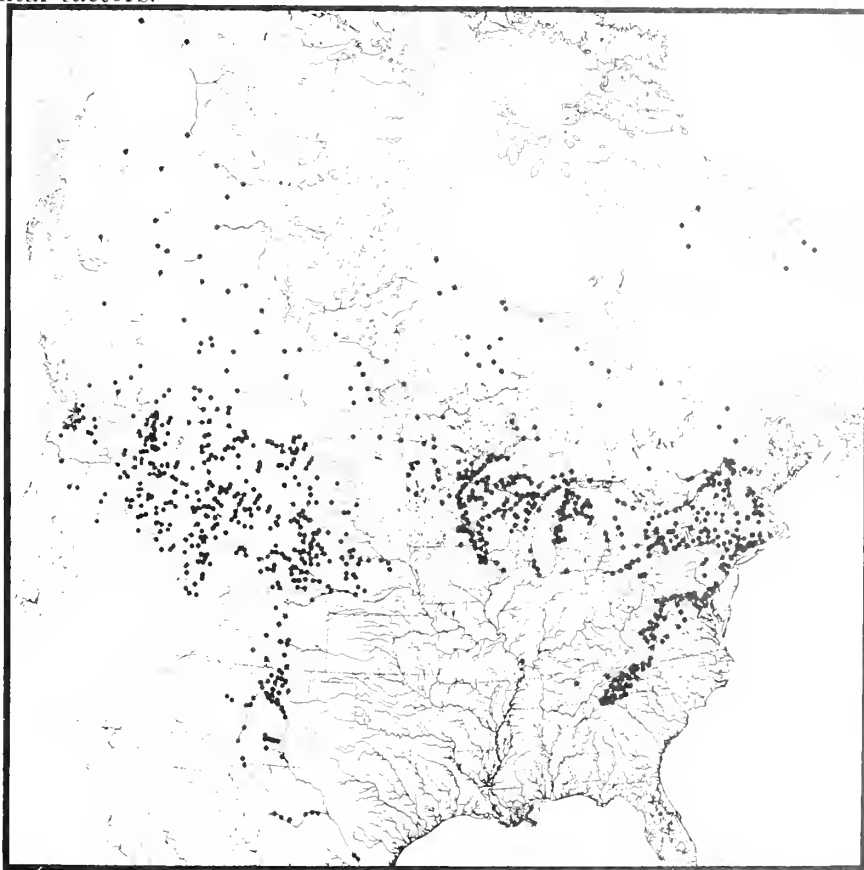
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Niagara Falls, NY (Valenciennes in Cuvier and Valenciennes 1842. *Histoire Naturelle des Poissons* 16: 1-472).

SYSTEMATICS: No comprehensive systematic studies of species throughout extensive range yet published. Bartnick (1972. Canadian J. Zool. 50:83-86) recognized *R. cataractae dulcis* as western subspecies, and described differences in nuptial coloration and spawning time from *R. c. cataractae*. Bailey and Allum (1962. *Fishes of South Dakota*) noted geographic variation in swim bladder development. Gee (1972. J. Fish. Res. Board Can. 29:119-27; 1974. J. Fish. Res. Board Can. 31:35-41) found variation in swimbladder size correlated with environmental developmental factors.



MD: Alleganey Co.,
Flintstone Creek (NCSM).



DISTRIBUTION AND HABITAT: Widely distributed from coast to coast in North America, including northern Mexico; ranges south in Appalachian and Rocky mountains. Apparently introduced to upper Roanoke drainage, VA. Normally common in swift streams with gravel beds, occasionally taken in lakes and clear pools of rivers. More ubiquitous on Atlantic slope than in west, where often common in riffles habitats. In turbid, swift waters in upper Great Plains.

ADULT SIZE: 75 mm.

BIOLOGY: Carlander (1969. *Handbook of Freshwater Fisheries Biology* Vol. 1) summarized biological data. Bartnick (1970. J.

Fish. Res. Bd. Can. 27:2125-41; and 1972) described gonadal development and reproductive habitat, behavior, and specific spawning time of this springtime breeder. McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*) noted that, in MT, females laid 200-1200 transparent, adhesive eggs that hatched in 7-10 days at 15.6°C. Food limited to benthic organisms (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Bangham and Adams (1954. J. Fish. Res. Board Can. 11:673-708) noted this species normally had few parasites.

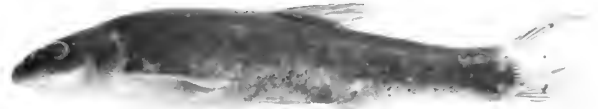
Compilers: C. R. Gilbert and J. R. Shute.
March 1978.

Rhinichthys evermanni Snyder
Umpqua dace

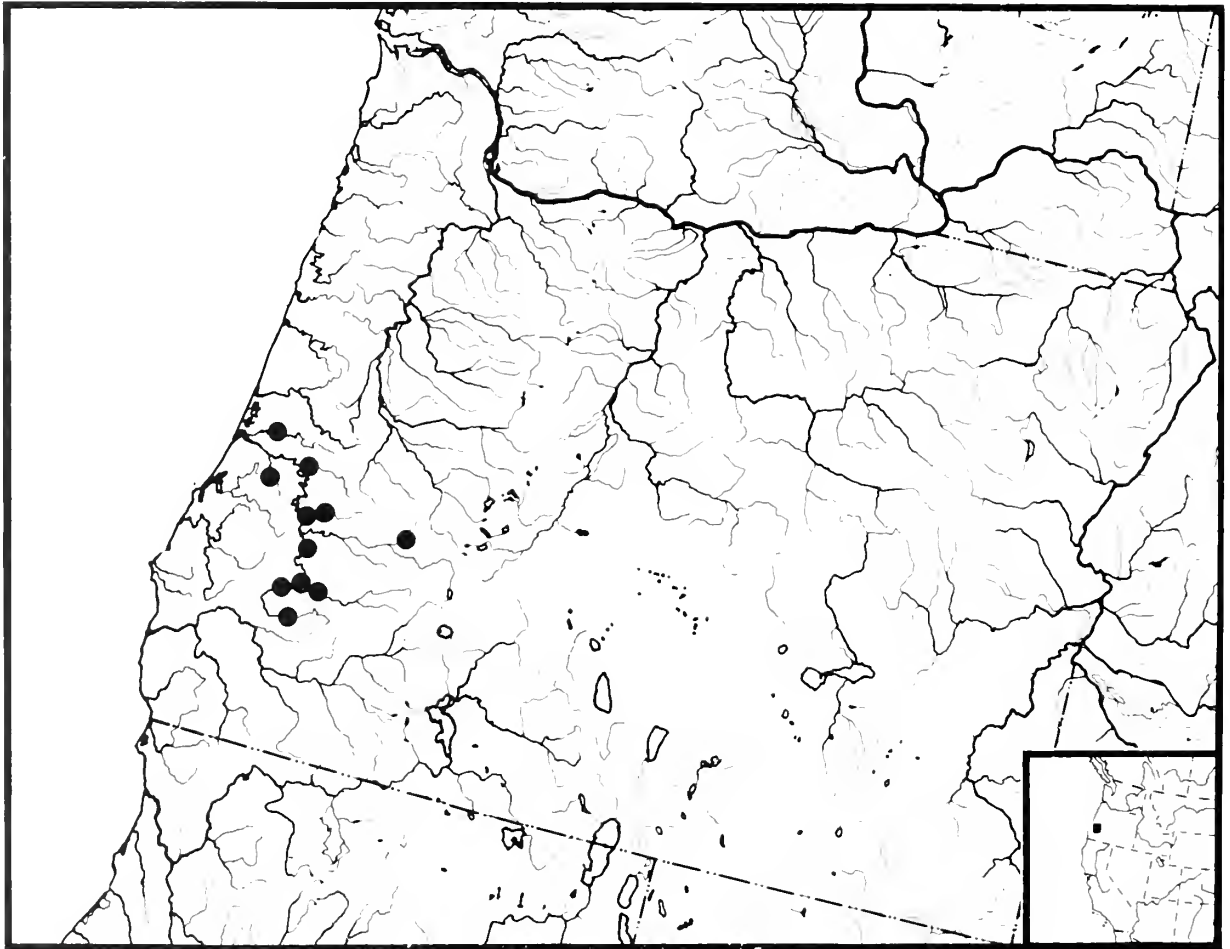
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: South Umpqua River, Roseburg, Douglas Co., OR (Snyder 1908. Bull. U.S. Bur. Fish. [1907] 27:153-89).

SYSTEMATICS: Closely related to *R. cataractae*, northwest United States populations which were compared with *R. evermanni* by Bisson and Reimers (1977. Copeia:518-22).



OR: Douglas Co., Mill Creek,
68 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Umpqua River and tributaries, OR. Frequents swift riffles.

ADULT SIZE: ca. 122 mm SL maximum.

BIOLOGY: Little known. Apparently similar to *R. cataractae*. Spawns in spring.

Compilers: C. E. Bond and K. M. Howe.
June 1979.

Rhinichthys falcatus (Eigenmann and Eigenmann)
Leopard dace

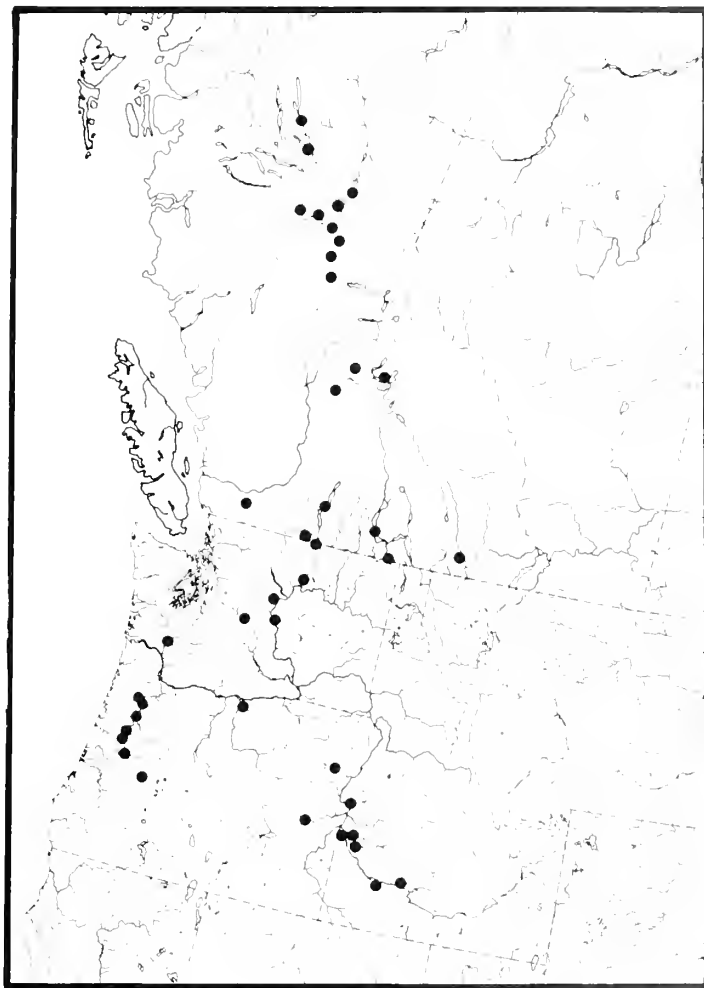
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Boise River, Caldwell, Canyon Co., ID (Eigenmann and Eigenmann 1893. Am. Nat. 27:151-54).

SYSTEMATICS: Originally described as *Agosia falcata*. Placed in subgenus *Apocope*, but possibly should be in separate genus because of distinctiveness (Hubbs et al. 1974. Mem. Calif. Acad. Sci. 7:1-259).



ID: Owyhee Co., Bruneau River, 53 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Fraser River, BC, and Columbia River drainage, OR, WA, and ID, but not above Shoshone Falls (Snake River, ID), Spokane Falls (Spokane River, WA) and Albeni Falls (Pend Oreille River, WA). McPhail (1967. Northwest Sci. 41:1-11) illustrated distribution in western WA. Stream species, usually preferring areas with slow current (Gee and Northcote 1963. J. Fish. Res. Board Can. 20:105-18).

ADULT SIZE: 45-75 mm SL.

BIOLOGY: No known studies on United States populations. Mainly insectivorous, and probably spawns in early July in BC (Gee and Northcote 1963). Johannes (1958. B. S. thesis, Univ. British Columbia) studied feeding relationships.

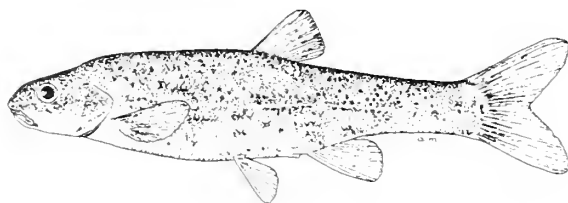
Compiler: R. L. Wallace, May 1979.

Rhinichthys osculus (Girard)
Speckled dace

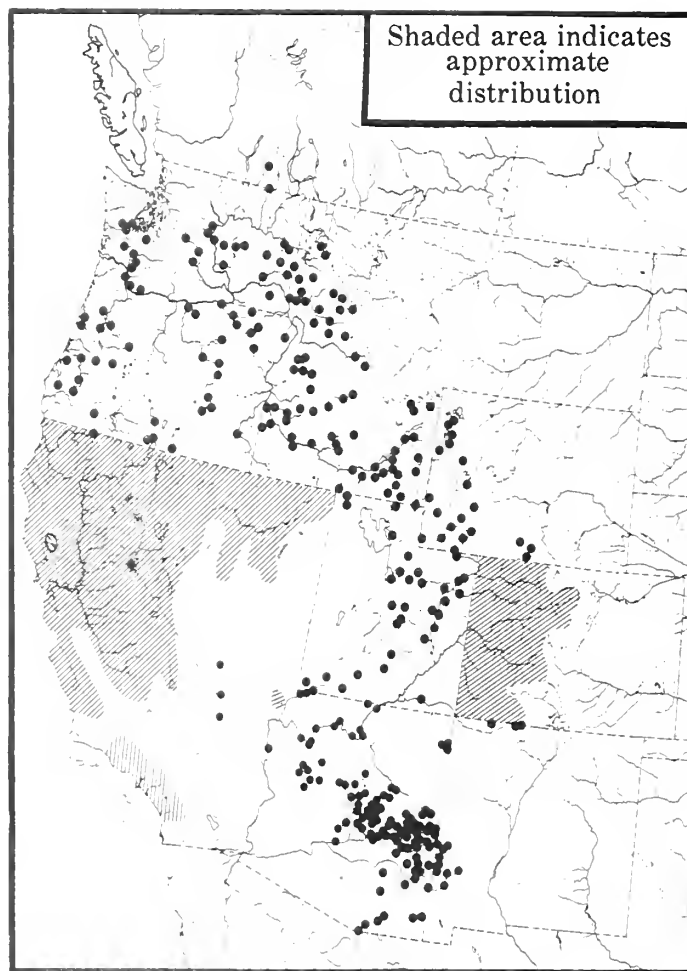
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Bobocomori Creek, tributary to San Pedro River, AZ (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Highly variable; large synonymy reviewed by La Rivers (1962. *Fishes and Fisheries of Nevada*). Hubbs et al. (1974. Mem. Calif. Acad. Sci. 7:1-259) also reviewed taxonomy, and followed Gilbert (1893. N. Am. Fauna 7:229-34) in placing it in subgenus *Apocope*.



CA: Placer Co., Sagehen Creek,
74 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Native to all major western drainages from Columbia River to Colorado River and south to Sonora, Mexico. Also in coastal drainages and interior waters. Mainly inhabits cool flowing streams with rocky substrate, but also in large and small lakes, warm permanent and intermittent streams, and outflows of desert springs (Moyle 1976. *Inland Fishes of California*). Most ubiquitous freshwater fish in western United States (Hubbs et al. 1974).

ADULT SIZE: 45-80 mm SL.

BIOLOGY: Nothing known of biology of northern populations (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Typically a bottom browser, feeding on small invertebrates, but also may feed on plant material. John (1963. Copeia:286-91) reported on reproductive cycle in AZ populations, and Baker (1967. Calif. Fish Game 53:165-73) studied aspects of biology in Lake Tahoe, CA.

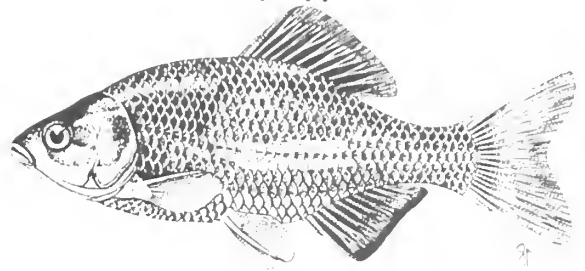
Compiler: R. L. Wallace. July 1978.

Rhodeus sericeus (Pallas)
Bitterling

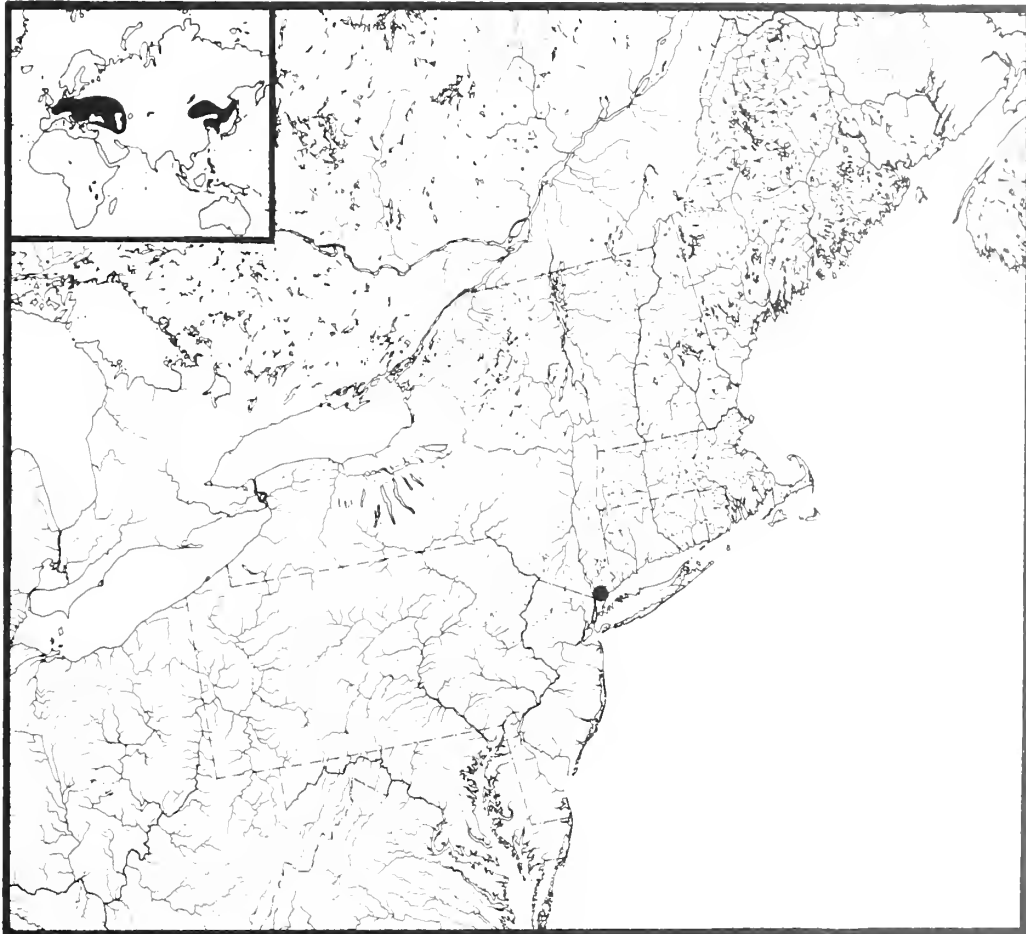
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Onon River (Pallas 1776, *Reise durch verschiedene Provinzen des Russischen Reiches* [1768-74] Vol. 3).

SYSTEMATICS: Two subspecies, *R.s. amarus* and *R.s. sericeus* (Berg 1949, *Fresh-water Fishes of the U.S.S.R. and Adjacent Countries*, Vol. 2). Included in key to fishes by Moore (in Blair et al. 1968, *Vertebrates of the United States*).



(NCSM)



DISTRIBUTION AND HABITAT: Native distribution — Still or slow-moving waters in Europe from France east to Asia Minor, and northern China. Introduced into Sawmill River, Tarrytown, Westchester Co., NY prior to 1923. Collected there as late as the 1940s. Established in Bronx River, Bronxville, NY. Not abundant. Introductions probably due to releases of aquarium fish.

ADULT SIZE: In native range 43-75 mm TL, 90 mm SL maximum.

BIOLOGY: Feeds mainly on phytoplankton in native range. Eggs are deposited, fertilized, and hatch in freshwater mussels; fry remain in mussels until free swimming. Will use American mussels *Anodonta cataracta* and *Unio complanatus* for breeding. Literature on reproduction reviewed by Breder and Rosen (1966, *Modes of Reproduction in Fishes*).

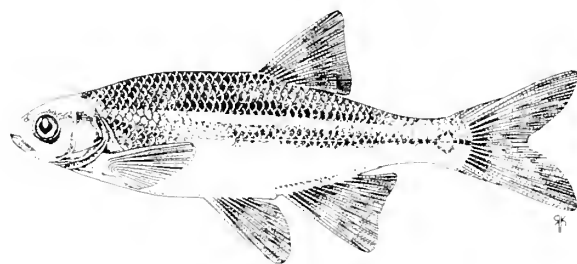
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Richardsonius balteatus (Richardson)
Redside shiner

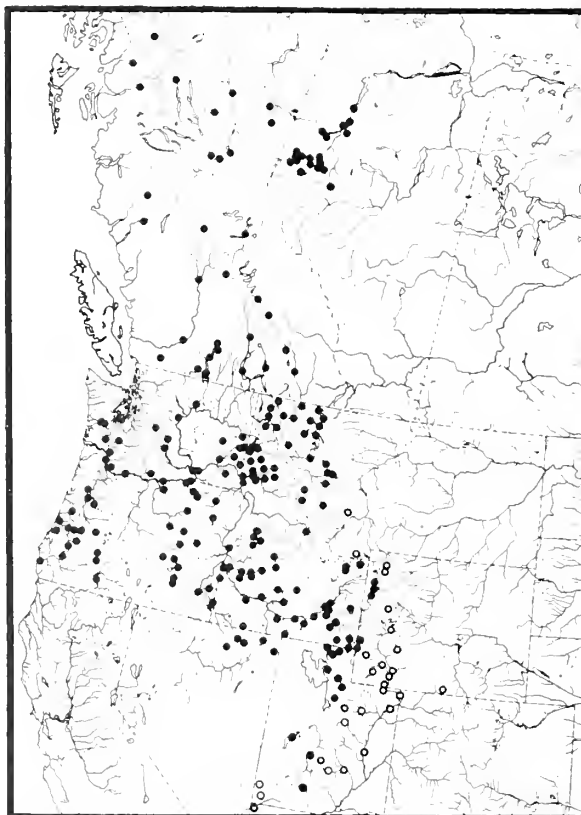
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Columbia River, supposedly at Fort Vancouver or vicinity (Richardson 1836. *Fauna Boreali-Americana*).

SYSTEMATICS: Has been placed in several genera and accumulated many synonyms (La Rivers 1962. *Fishes and Fisheries of Nevada*). McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*) briefly reviewed taxonomy of species. Highly variable with regard to anal ray count, which is main basis for recognition of two subspecies: *R. b. balteatus* and *R. b. hydrophlox*.



UT: Boise River, 71 mm SL
(NCSM).



Open circles transplanted
populations

DISTRIBUTION AND HABITAT: Native distribution mostly west of Rocky Mountains in North America from Nass River, BC, south through WA, OR, and Columbia drainage. Also in Harney Basin, OR (Bisson and Bond 1971. *Copeia*:268-81) and Bonneville Basin, ID, WY, UT, and NV. Native east of continental divide only in BC and AT in Peace system (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Introduced into upper Missouri basin MT (Brown 1971. *Fishes of Montana*) and upper Colorado drainage in WY (Baxter and Simon 1970. *Wyoming Fishes*), UT (Sigler and Miller 1963. *Fishes of Utah*), and AZ (Minckley 1973. *Fishes of Arizona*). Found in variety of habitats including lakes, ponds, ditches, springs and sloughs, and rivers and creeks, usually where current is slow or lacking.

ADULT SIZE: 55-80 mm SL.

BIOLOGY: Omnivore, feeding mainly on aquatic and terrestrial insects. Spawns in spring and early summer (Weisel and Newman 1951. *Copeia*:187-94; Lindsey and Northcote 1963. *J. Fish. Res. Board Can.* 20:1001-30). Movements in and out of lakes studied by Lindsey and Northcote (1963). Predator-prey relationships of introduced redside shiners and native trout in lakes well studied (Larkin and Smith 1954. *Trans. Am. Fish. Soc.* 83:161-75; Crossman 1959. *J. Fish. Res. Board Can.* 16:247-67; 1959. *J. Fish. Res. Board Can.* 16:269-81; Crossman and Larkin 1959. *Trans. Am. Fish. Soc.* 88:36-44; and Johannes and Larkin 1961. *J. Fish. Res. Board Can.* 18:203-20).

Compiler: R. L. Wallace. July 1978.

Richardsonius egregius (Girard)
Lahontan redbside shiner

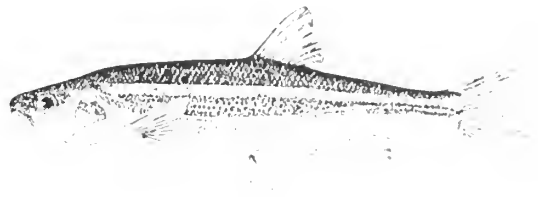
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: No locality given (Girard 1858. U.S. Pac. R. R. Surv. 4:1-400), but Snyder (1921. Proc. U.S. Natl. Mus. 59: 23-28) recorded it as Humboldt River, and Jordan et al. (1930. Rept. U.S. Fish Comm. 10:1-670) restricted it to Humboldt River, at Imlan, NV.

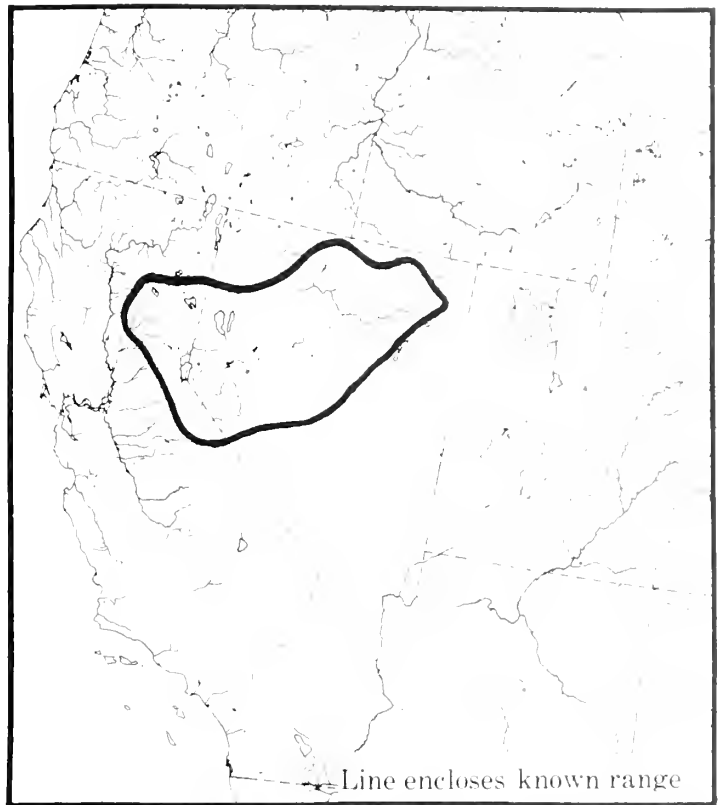
SYSTEMATICS: Genus related to *Clinostomus* and *Gila* (Uyeno 1961. Ph.D. diss. Univ. Michigan; Buhan 1969. Ph.D. diss. Virginia Polytech. Inst. State Univ.). Principal external difference between *R. egregius* and other member of genus, *R. balteatus*, is anal ray number (Lindsey 1953. Can. J. Zool. 31:211-25; Weisel 1961. Copeia: 270-74). Hybridizes with *Gila bicolor* and *Rhinichthys osculus* (Calhoun 1940. Copeia: 142-43; Hopkirk and Behnke 1966. Copeia: 134-36).

DISTRIBUTION AND HABITAT: Lahontan Basin and related waters of NV and CA. Walker, Carson, Truckee, Susan, Quinn, Reese, and Humboldt rivers; Walker, Tahoe, and Pyramid lakes; and tributary streams and ponds. Very common throughout most of native range. Littoral zone dweller in Lake Tahoe (Moyle 1976. *Inland Fishes of California*). Found in deep, quiet waters as well as swift currents of high mountain tributaries. Congregates around submerged logs, wharves, and other sheltered places (Snyder 1918. Bull. U.S. Bur. Fish. 27: 69-102).

ADULT SIZE: 67 - 77 mm SL, 140 mm SL maximum.



CA: Placer Co., Sagehen Creek,
11 cm SL (Moyle 1976).



Line encloses known range

BIOLOGY: Occurs in large schools (Snyder 1918) at depths of less than 10 m, but some collected at 30 m (Evans 1969. Calif. Fish Game 55:197-220). Disappearance from shallow areas after temperatures drop below 10°C implies relative inactivity during winter (Moyle 1976). Matures in third or fourth summer. Spawns May and June in NV (LaRivers 1962. *Fishes and Fisheries of Nevada*), and June and July, at about 17°C, over gravel at 200-450 mm depth along shore in Lake Tahoe (Miller 1951. Ph.D. diss., Univ. Minnesota). Brightly colored during spawning. Feeds predominantly on insects, insect larvae, and planktonic crustaceans, but also eats sucker eggs. Prefers flying insects at night, and bottom and planktonic forms during day (Moyle 1976).

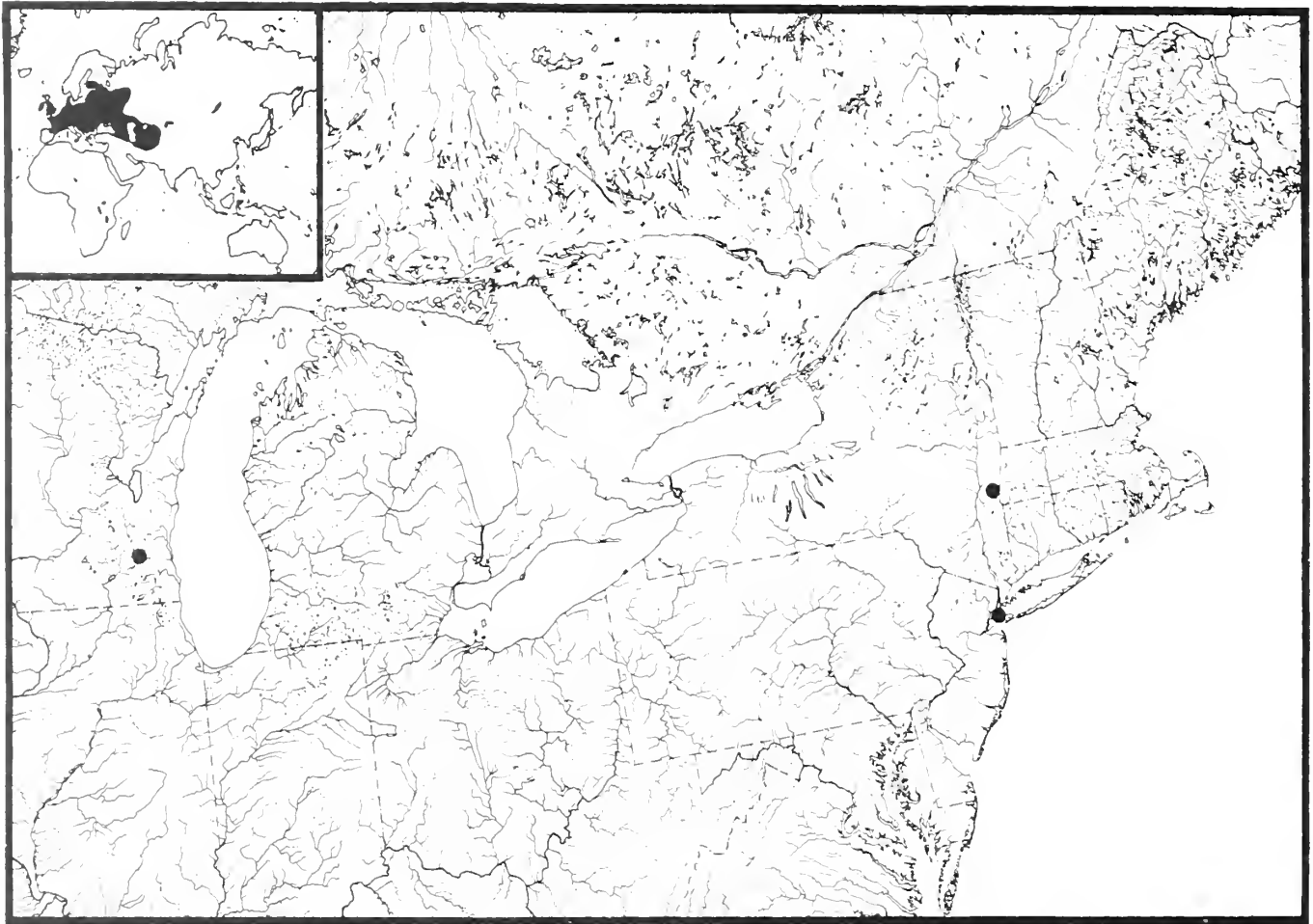
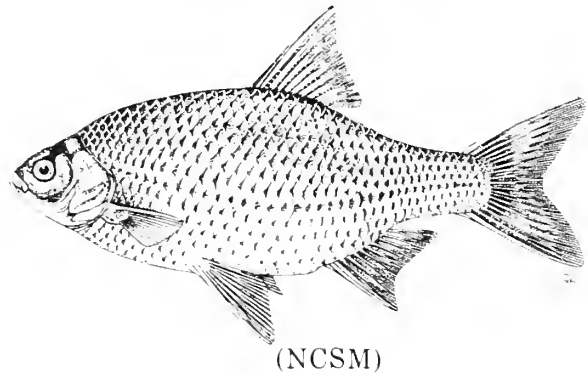
Compiler: A. W. Allen-Grimes. October 1979.

Scardinius erythrophthalmus
(Linnaeus)
Rudd

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Northern Europe
(Linnaeus 1758. *Systema naturae*, Laurentii
Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Two subspecies, *S.e.*
scardafa and *S.e. erythrophthalmus* (Berg
1949. *Freshwater Fishes of the U.S.S.R.*
and *Adjacent Countries*, Vol. 2). Included
in key to United States fishes by Moore
(in Blair et al. 1968. *Vertebrates of the*
United States).



DISTRIBUTION AND HABITAT: Native
distribution — Still or slow-moving waters
of Europe, Ural River, Emba River, Asia
Minor, southern coast of the Caspian Sea,
and the Aral Sea basin. Established in NY;
possibly established in NJ and WI. Introduced
into United States by a state conservation
department and private citizens.

ADULT SIZE: In native range 200-250 mm
TL, 400 mm SL maximum.

BIOLOGY: In native range adults feed
mainly on surface or aerial insects; young
feed mainly on diatoms, algae, and copepods.
Adhesive eggs are laid in submerged vege-
tation in shallow water near shore. Infor-
mation on reproduction and growth sum-
marized by Breder and Rosen (1966. *Modes*
of Reproduction in Fishes) and Wheeler
(1969. *The Fishes of the British Isles and*
north-west Europe).

Compilers: D. A. Hensley and W. R. Courte-
nay, Jr. November 1979.

Semotilus atromaculatus (Mitchill)
Creek chub

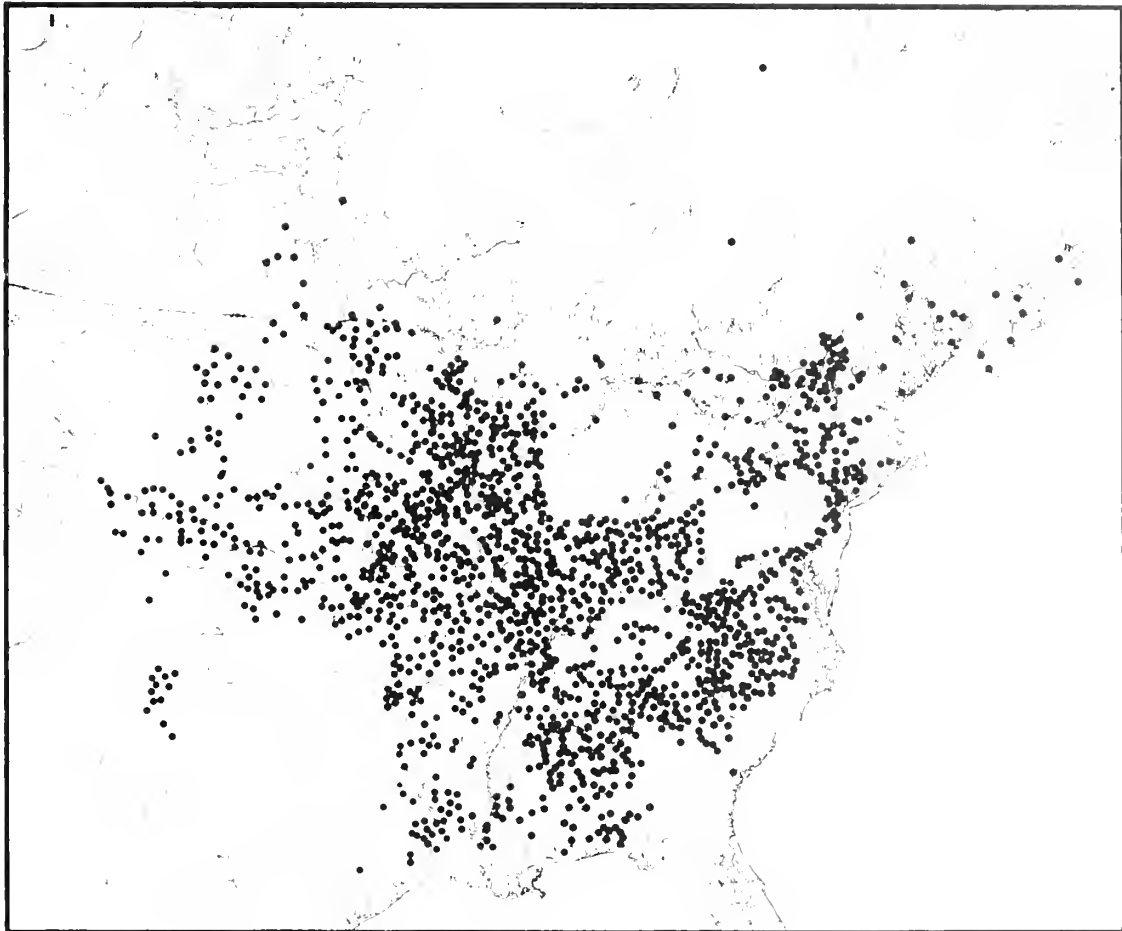
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Wallkill River, NY (Mitchill 1818. Am. Mon. Mag. Crit. Rev. 2:241-48, 321-28).

SYSTEMATICS: Although two subspecies have been recognized, Bailey et al. (1954. Proc. Acad. Nat. Sci. Phila. 106:109-64) considered differences clinal and no longer recognized *S. a. thoreauianus*, the southeastern form. Characters of Atlantic slope, NC, populations treated by Snelson and Suttkus (1978. Bull. Ala. Mus. Nat. Hist. 3:1-11).



MD: Garrett Co., Muddy
Creek, 97 mm TL (NCSM).



DISTRIBUTION AND HABITAT: Throughout most of eastern North America, from MB, MT, and northern NM east to Atlantic slope. Absent from peninsular FL and Coastal Plain of southeastern states. Abundant in small streams and clear creeks and brooks; occasionally in shallows of small, clear lakes.

ADULT SIZE: 102-280 mm TL, 305 mm TL maximum.

BIOLOGY: Reproduction described by Richardson (1935. Ph.D. diss., McGill Univ.) and Reighard (1910. Bull. Bur. Fish. 28: 1111-36); early life history stages noted by Fish (1932. Bull. U.S. Bur. Fish. 47: 293-398). Omnivorous sight feeder; insects, cladocerans, algae, and higher plant tissues constitute significant part of diet (Leonard 1927. Univ. Toronto Stud. Biol. Sec. 28 Publ. Ont. Fish. Res. Lab. 30:35-44).

Compilers: D. S. Lee and S. P. Platania.
June 1978.

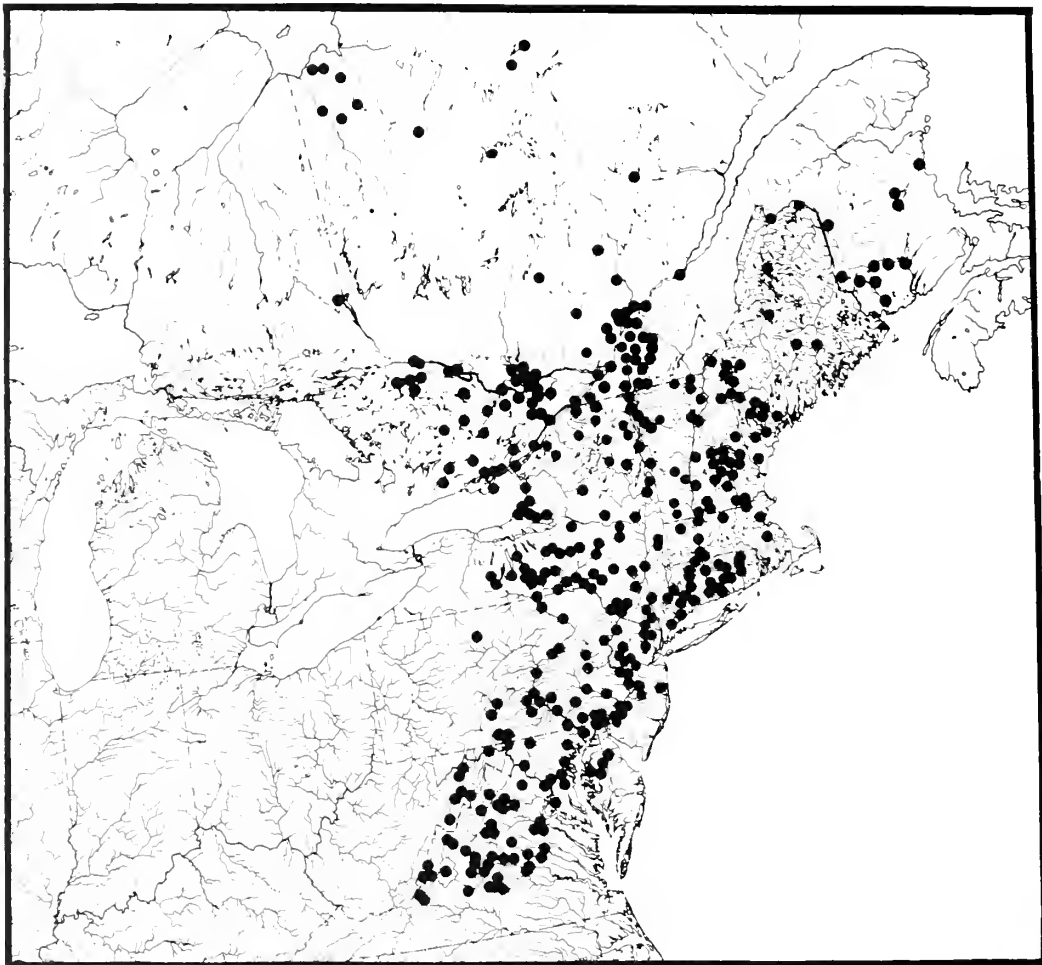
Semotilus corporalis (Mitchill)
Fallfish

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Wallkill River, NY (Mitchill 1817. Am. Mon. Mag. Crit. Rev. 1:289-90).

SYSTEMATICS: No comprehensive species review available. No indication that geographically distinct populations exist. Systematics discussed by Scott and Crossman (1973. *Freshwater Fishes of Canada*).

MD: Montgomery Co., Goshen Branch, 66 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Largely restricted to Atlantic slope, from James River drainage in VA, north to Miramichi drainage in NB. Also in Lake Ontario and St. Lawrence drainages in NY and southern Canada (QU and ON), as well as James Bay watershed of QU and ON. Common in clear, gravel to rubble-bottomed streams of medium to large size, and may also occur, north, in lakes.

ADULT SIZE: 98-243 mm TL, 445 mm TL maximum.

BIOLOGY: Numerous publications dealing with various aspects of life history and ecology have appeared. Most complete summaries by Adams and Hankinson (1928. Roosevelt Wild Life Ann. 1:235-548), Scott and Crossman (1973), Reed (1971. Trans. Am. Fish Soc. 100:717-25), and Ross and Reed (1978. Copeia :215-21).

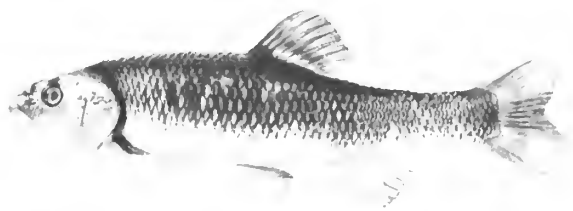
Compiler: C. R. Gilbert. March 1978.

Semotilus lumbee Snelson and
Suttkus
Sandhills chub

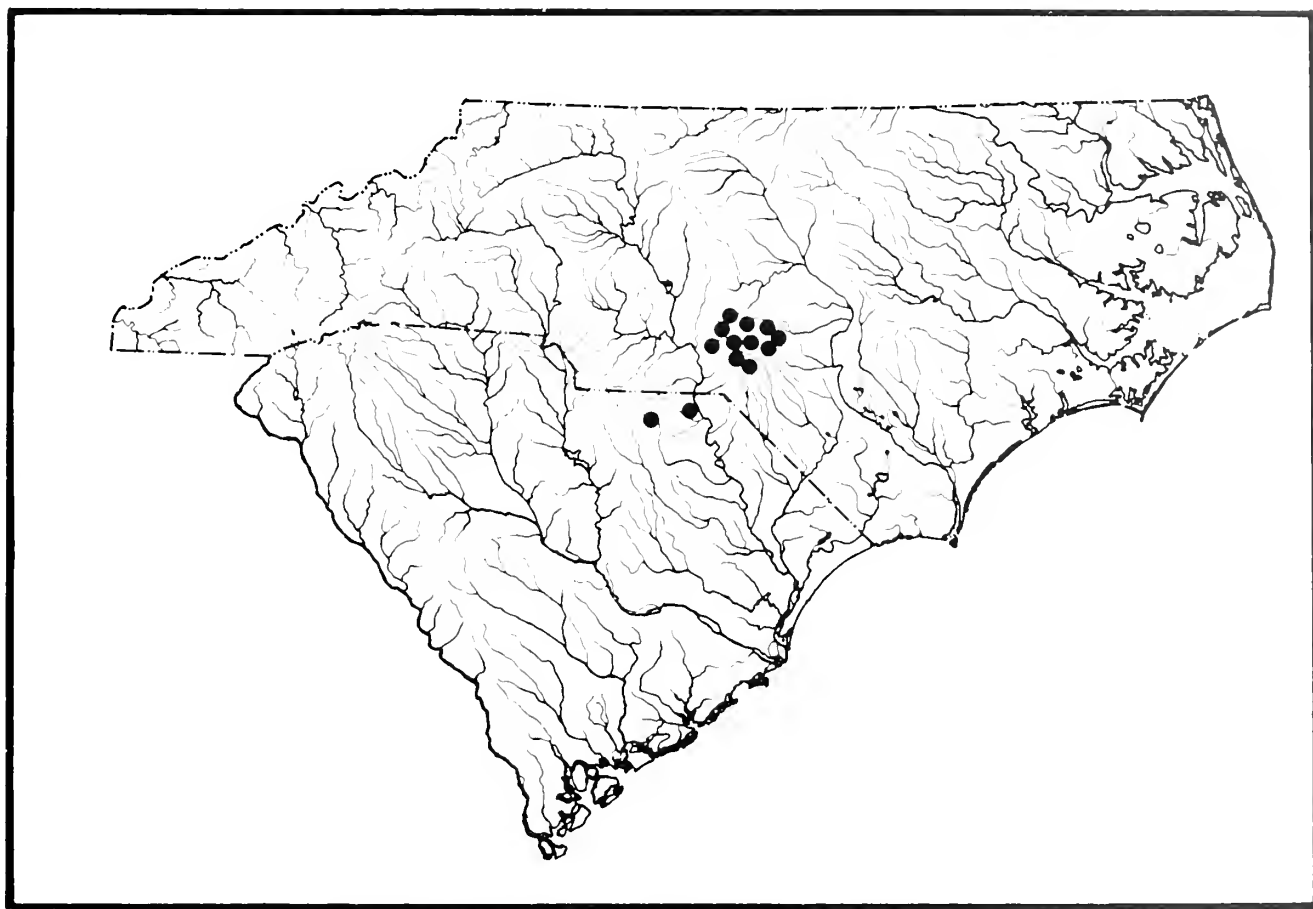
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributary of Aberdeen Creek at U.S. hwy. 1 bridge, 0.8 km sw Aberdeen, Lumber River drainage, Moore Co., NC (Snelson and Suttkus 1978. Bull. Ala. Mus. Nat. Hist. 3:1-11).

SYSTEMATICS: Closely related to *S. atromaculatus*. No noteworthy geographic variation. Unique in genus in possessing nine principal dorsal fin rays.



NC: Moore Co., tributary of Aberdeen Creek, male, 151 mm SL (F. F. Snelson).



Map modified from Snelson and Suttkus 1978

DISTRIBUTION AND HABITAT: Restricted to small geological area called Carolina Sandhills, in southcentral NC and northcentral SC. Center of distribution is upper Lumber River system (Peedee drainage). Also in adjacent tributaries of Yadkin and Cape Fear drainage. Two SC records are 80 km from center of distribution. Occupies small to medium-sized, slow-flowing creeks with sand and gravel bottoms and sparse vegetation. Occasional to common in Lumber system, uncommon elsewhere.

ADULT SIZE: 80-200 mm SL.

BIOLOGY: Little known. Male may build gravel mound-pit nest in spring for spawning, as does *S. atromaculatus*. Adult female smaller than male. Snelson and Suttkus (1978) discussed conservation status.

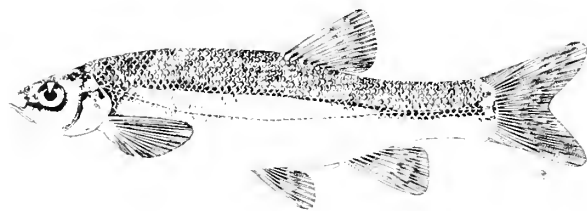
Compiler: F. F. Snelson, Jr. September 1978.

***Semotilus margarita* (Cope)**
Pearl dace

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Tributary of Conestoga River, Lancaster, PA (Cope in Günther 1868. *Catalogue of the Fishes in the British Museum* 7:1-512).

SYSTEMATICS: Four subspecies proposed, based largely on scale number. Scott and Crossman (1973. *Freshwater Fishes of Canada*) suggested this character and number of pectoral rays may be clinal. Bailey and Allum (1962. *Fishes of South Dakota*) recognized and mapped the subspecies *S. m. margarita* and *S. m. nachtriebi*. Thorough study of material throughout range is desirable.



MD: Washington Co., Conococheague confluence, 84 mm SL (NCSM)



DISTRIBUTION AND HABITAT: Northern United States and Canada. NS and Labrador west along southern shore of Hudson Bay to southern NT (Sass River) and BC. South in United States to northern MT, east to VA. Relict populations in SD, NB, and IA. Often common in cool bog ponds, springs, creeks, and lakes.

ADULT SIZE: 65-120 mm TL; 158 mm TL maximum.

BIOLOGY: Spawns in spring in clear water with moderate current over sand or gravel. Males maintain territories about 200 mm in width but do not build nests (Langlois 1929. *Ecology* 10:161-63). Loch (1969. *Dept. Zool. Univ. Toronto*:1-34) reported on age and growth. Food consists of copepods, cladocerans, beetles, filamentous algae, and *Chara* (Carlander 1969. *Handbook of Freshwater Fishery Biology* Vol. 1; McPhail and Lindsey 1970. *Freshwater Fishes of Northwest Canada and Alaska*). Major published reports summarized by Scott and Crossman (1973).

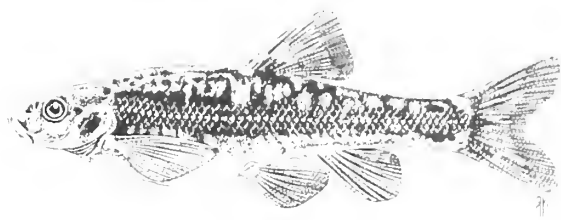
Compilers: D. S. Lee and C. R. Gilbert.
January 1979.

Tiaroga cobitis Girard
Loach minnow

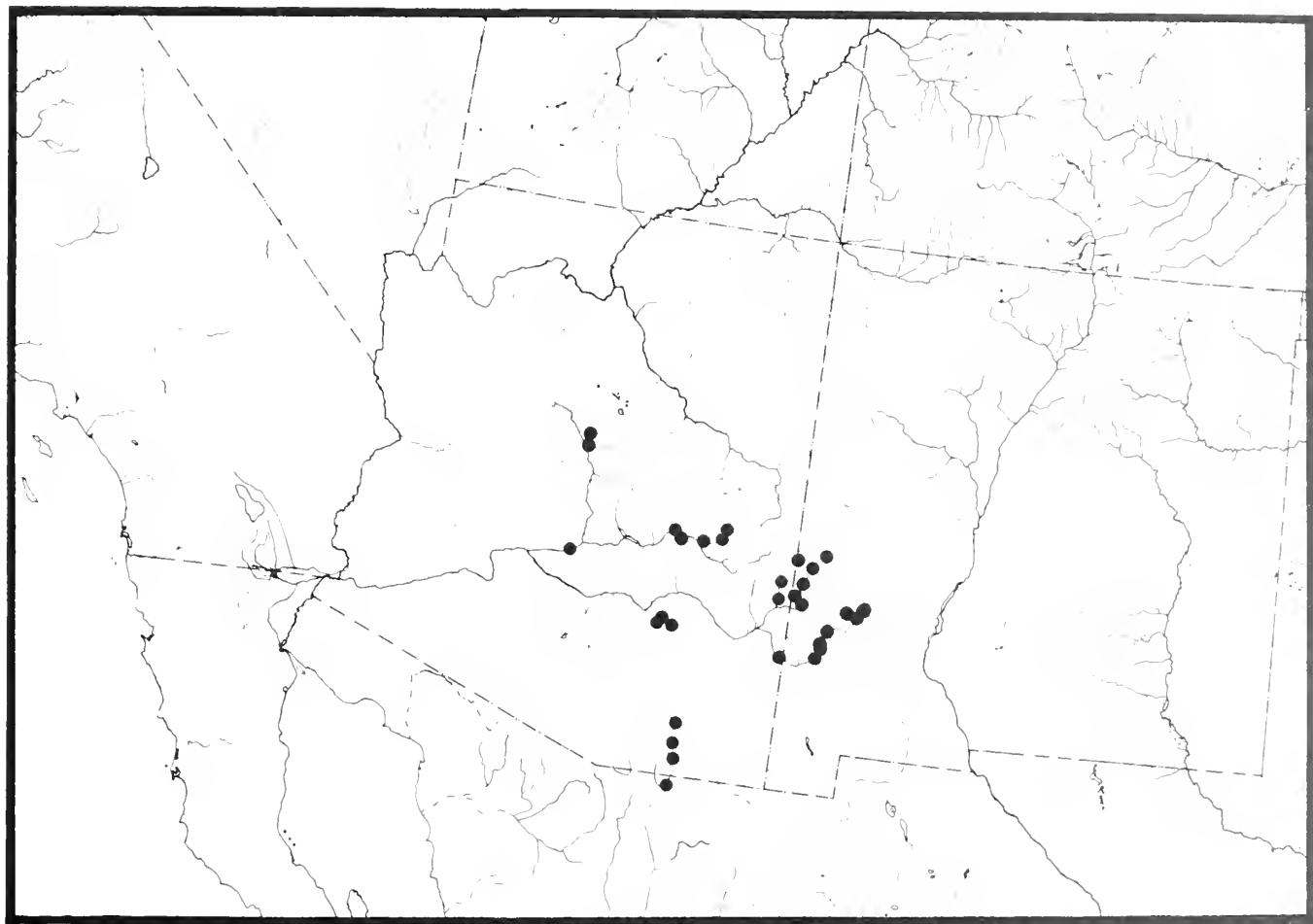
Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: San Pedro River, AZ, probably near mouth of Babacomari River, Cochise Co. (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Monotypic genus, presumably related to *Rhinichthys*-like stock of western cyprinids.



AZ: Graham Co., Aravaipa Creek, male, 63 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Restricted to upper Gila River basin, AZ and NM (Minckley 1973. *Fishes of Arizona*; Koster 1957. *Guide to the Fishes of New Mexico*), and extreme northern Sonora (Miller and Winn 1951. J. Wash. Acad. Sci. 41:83-84). Widely extirpated in AZ by dewatering of streams and interaction with introduced *N. lutrensis* (Minckley and Deacon 1968. Science 159:1424-32); locally common in NM. Lives on bottom in small to large creeks and rivers, typically on turbulent riffles in association with filamentous algae; habitat resembles that of many eastern darters (Percidae).

ADULT SIZE: Rarely exceeds 60 mm TL.

BIOLOGY: Remarkably restricted in diet to riffle-inhabiting baetid mayflies and simuliid dipterans (Schreiber 1978. M. S. thesis, Arizona State Univ.). Spawns late winter and early spring, in second summer of life, producing 250 to 1,200 ova per female (Minckley 1973). Minckley (1965. Copeia: 380-83) studied sexual dimorphism.

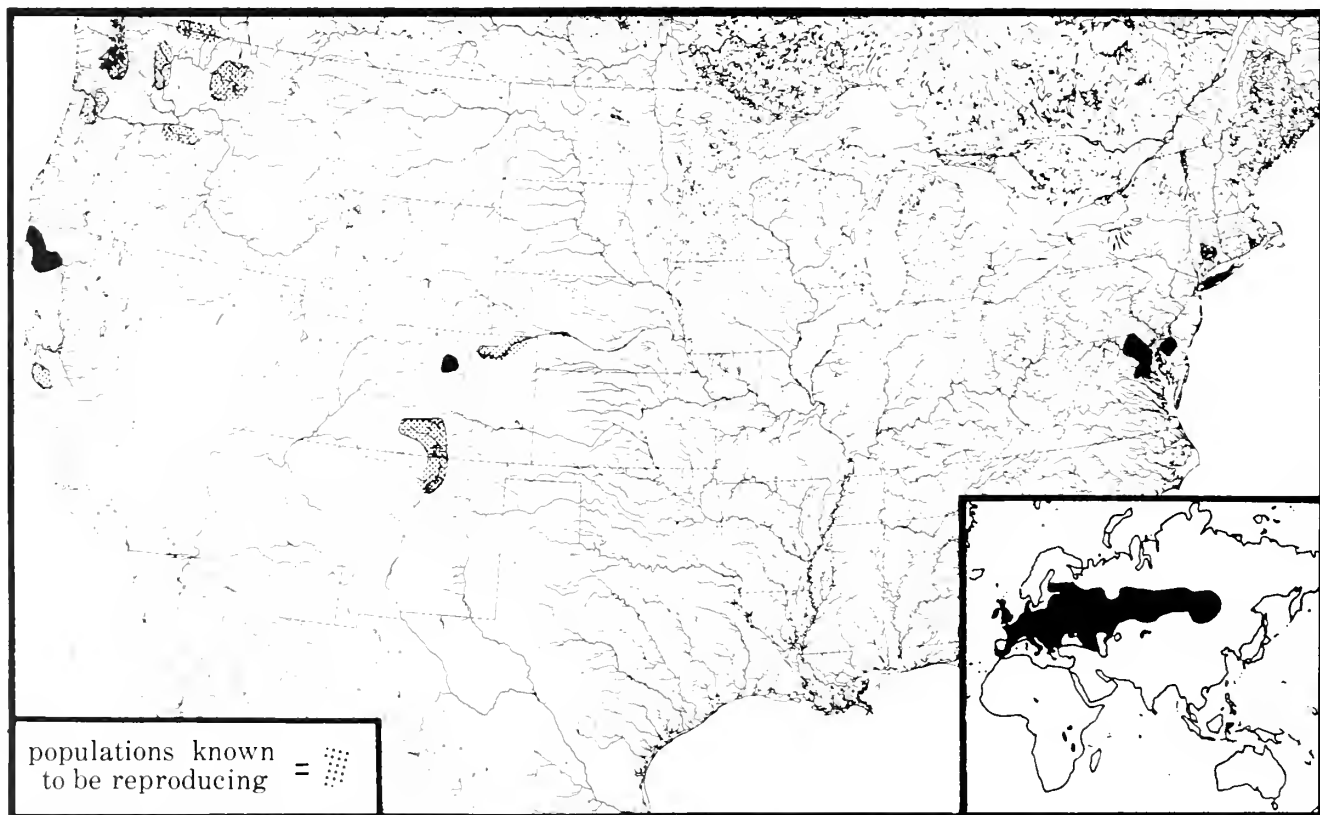
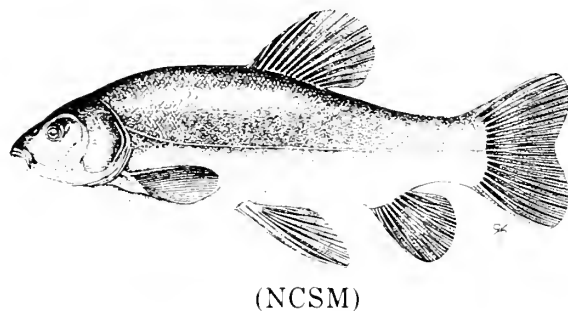
Compiler: W. L. Minckley. July 1979.

Tinca tinca (Linnaeus)
Tench

Order Cypriniformes
Family Cyprinidae

TYPE LOCALITY: Europe (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Genus monotypic. Illustration, description, and discussion of systematics in Berg (1949. *Freshwater Fishes of the U.S.S.R. and Adjacent Countries*, Vol. II). Included in keys to fishes of United States by Moore (in Blair et al. 1968. *Vertebrates of the United States*), Canada by Scott and Crossman (1973. *Freshwater Fishes of Canada*), and several works on fishes of particular regions or states.



DISTRIBUTION AND HABITAT: Native distribution — Western Europe, east to Ob and Yenisei basins and Lake Baikal. Established in BC, WA, OR, CA, ID, CO, NM, and CT; possibly established in NY, DE, and MD; has been collected in MO and AZ. Found predominantly in lakes or backwater areas of rivers; can live in poorly oxygenated waters. Was reported as abundant at certain localities in 1940s. Distributed to 36 states by U.S. Fish Commission in 1886-1896; introduced privately in CA; spread to BC from WA via Columbia River.

ADULT SIZE: In native range average 305 mm TL, 700 mm SL maximum.

BIOLOGY: In native range adults feed mainly on benthic invertebrates; young feed to some degree on algae (Wheeler 1969. *The Fishes of the British Isles and north-west Europe*). Mature males with thickened second pelvic ray. Adhesive eggs laid over submerged vegetation. Literature on spawning summarized by Breder and Rosen (1966. *Modes of Reproduction in Fishes*).

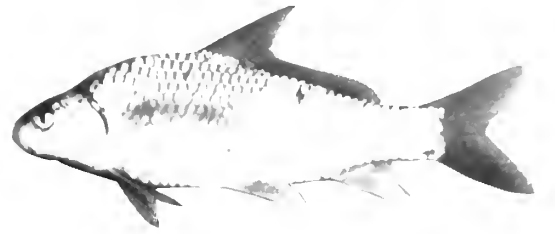
Compilers: D. A. Hensley and W. R. Courtenay, Jr. February 1979.

***Carpiodes carpio* (Rafinesque)**
River carpsucker

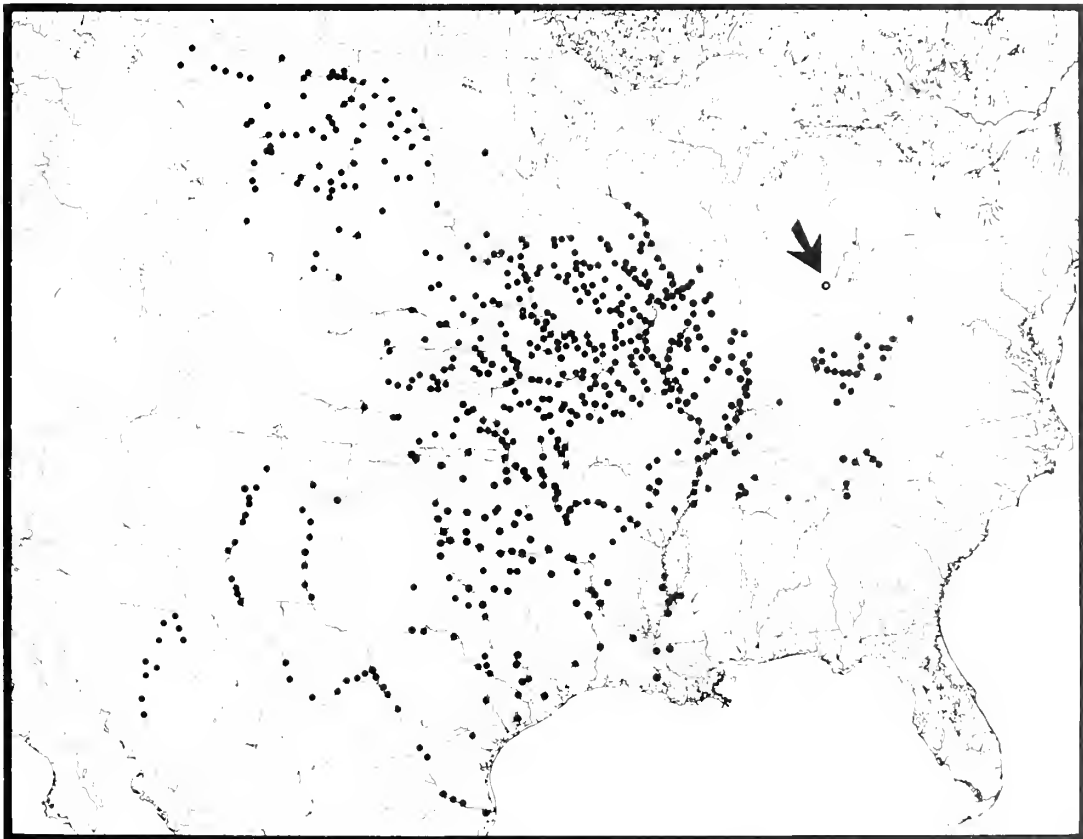
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Falls of Ohio River, below Louisville, KY (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Nomenclature treated by Hubbs (1930. Misc. Publ. Univ. Mich. Mus. Zool. 20:1-47) and systematics by Hubbs and Black (1940. Copeia 4:226-230), who recognized populations in Mexico and TX drainages as *C. c. elongatus*.



MO: Boone Co., Missouri River
at Rocheport (Mo. Dept. Cons.).



Open circle transplanted population

DISTRIBUTION AND HABITAT: Mississippi basin from PA to MT south to Gulf of Mexico; Gulf drainages from lower Mississippi River west to Rio Grande drainage and south in additional drainages of Mexico (Hubbs and Black 1940). Presumably introduced into western Lake Erie between 1920-1930 (Trautman 1957. *The Fishes of Ohio*). Abundant in quiet, silt-bottomed pools of rivers having low to moderate gradients, and frequently in impoundments.

ADULT SIZE: 305-380 mm TL.

BIOLOGY: Pflieger (1975. *The Fishes of Missouri*) reported adults in breeding condition from mid-May to late June. Brezner (1958. Prog. Fish-Cult., 20:170-04) and Brown and Thoreson (1951. Mont. State Coll. Agric. Exp. Stan. Bull. 480:1-30) studied food habits. Age, size, and growth data summarized by Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1).

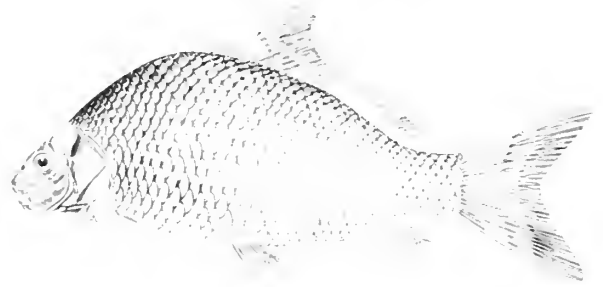
Compilers: D. S. Lee and S. P. Platania.
June 1978.

***Carpiodes cyprinus* (Lesueur)**
Quillback

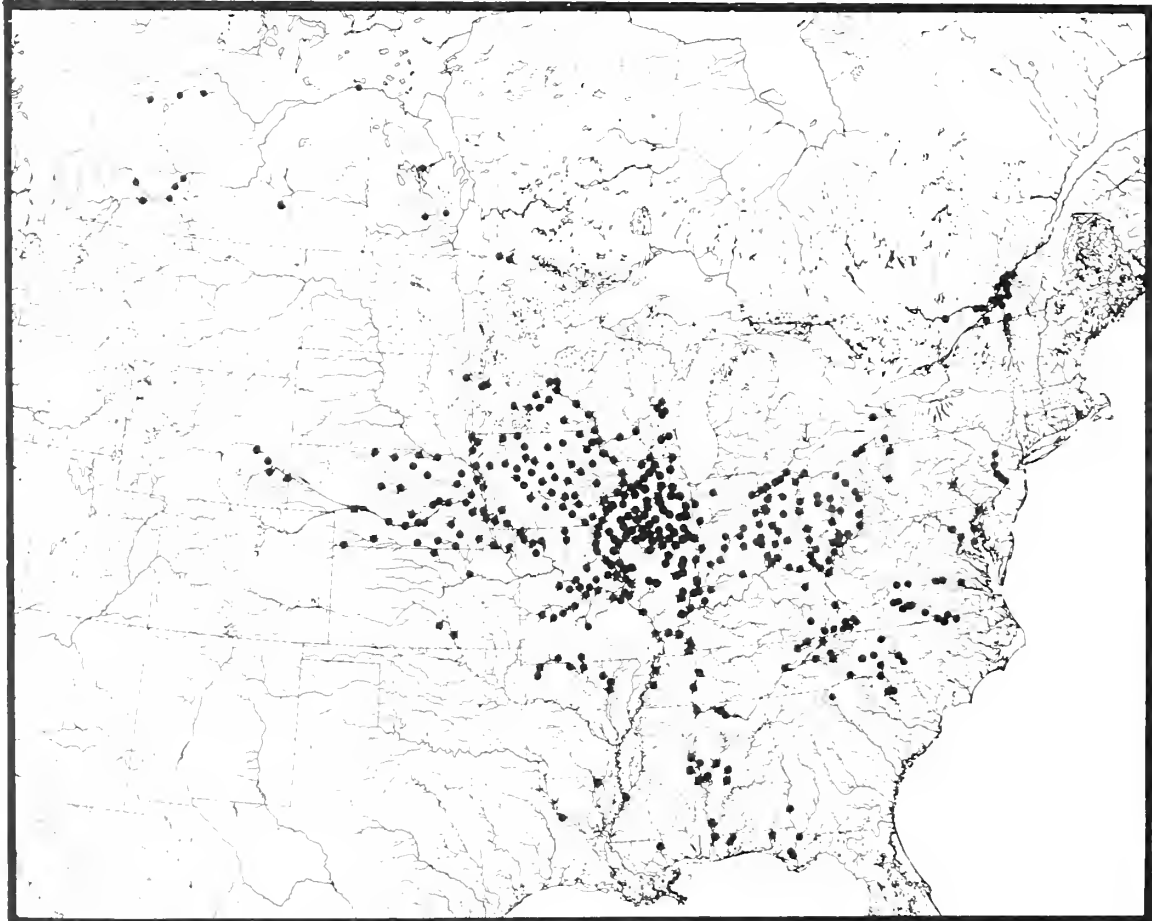
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Elk River, MD, and other tributaries of Chesapeake Bay (Lesueur 1817. J. Acad. Nat. Sci. Phila. 1:88-96, 102-11).

SYSTEMATICS: Nomenclature treated by Hubbs (1930. Misc. Publ Univ. Mich. Mus. Zool. 20:1-47). Bailey and Allum (1962. Misc. Publ. Univ. Mich. Mus. Zool. 119:1-131) discussed problems of forms in Mississippi basin, including *C. c. forbesi* in Plains and Ozarks and *C. c. hinei* in Ohio basin. Systematics, particularly of Gulf and southeastern Atlantic slope populations, remains poorly known.



MD: Harford Co., Havre de Grace (NCSM).



DISTRIBUTION AND HABITAT: Major Atlantic slope drainages including St. Lawrence River, and from Delaware drainage, NJ and PA, to Altamaha drainage GA, except no records for Rappahannock and York drainages, VA, or Tar and Neuse drainages, NC. On Gulf slope in Mobile and Apalachicola drainages, AL, FL, and GA. Widespread in Mississippi basin from GA, FL, and AL to OK and KS, north to ND and into central AT, east along Great Lakes to NY. Fairly abundant, in both turbid rivers and clear lakes.

ADULT SIZE: 381-660 mm SL.

BIOLOGY: Vanicek (1961. Proc. Iowa Acad. Sci. 68:238-46) discussed age and growth. Fish (1932. Bull. U.S. Bur. Fish. 47:293-398) illustrated early development and Hoffman (1967. *Parasites of North American Freshwater Fishes*) discussed parasites. As with most suckers, feeds on insect larvae and organisms found within bottom sediments. Beecher (1977. Abstr. 57th Ann. ASIH) compared ecology of *C. cyprinus* and *C. velifer* in FL.

Compilers: S. P. Platania and R. E. Jenkins.
June 1978.

***Carpiodes velifer* (Rafinesque)**
Highfin carpsucker

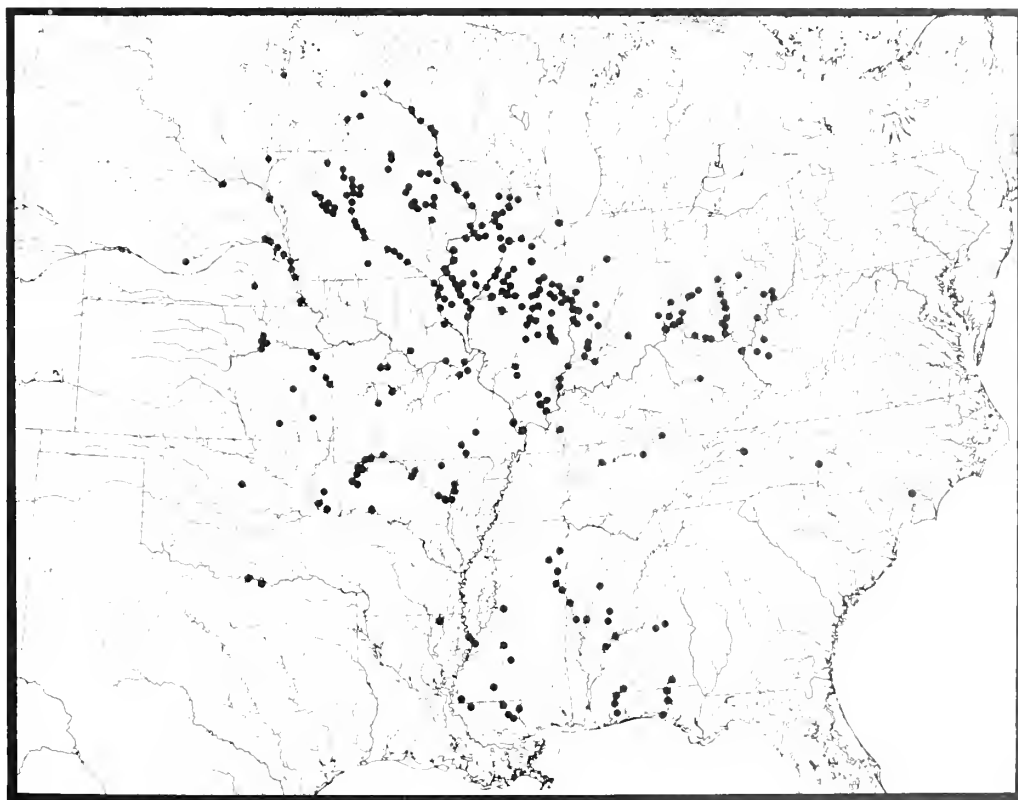
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Ohio River (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: No definitive study yet conducted. Nomenclature treated by Hubbs (1930. Misc. Publ. Univ. Mich. Mus. Zool. 20: 1-47). Taxonomic status of Gulf and Atlantic slope populations not clear (Bailey et al. 1954. Proc. Acad. Nat. Sci. Phila. 106:109-64; Dahlberg and Scott 1971. Bull. Ga. Acad. Sci. 29:1-64; Menhinick et al. 1974. J. Elisha Mitchell Sci. Soc. 90:24-50).



MO: Jefferson Co., Big River at
Byrnes Mill, 234mm SL (Mo.
Dept. Cons.).



DISTRIBUTION AND HABITAT: Single old Great Lakes record from a Lake Michigan tributary near Chicago (Smith 1971. Ill. Nat. Hist. Surv. Biol. Notes 76:1-14) may relate to dispersal via canal (Greene 1935. *The Distribution of Wisconsin Fishes*). Mississippi basin south to Arkansas drainage in OK and AR and Tennessee drainage in AL and TN. Reported from Mississippi River by Cook (1959. *Freshwater Fishes of Mississippi*). On Gulf slope from Pearl drainage, LA, to Choctawhatchee drainage, AL and GA, and Atlantic slope from Altamaha drainage, GA, to Cape Fear drainage, NC. Prefers clean water and firmer substrate than *C. carpio* and appears to be somewhat intolerant of siltation and turbidity.

ADULT SIZE: 225-305 mm TL.

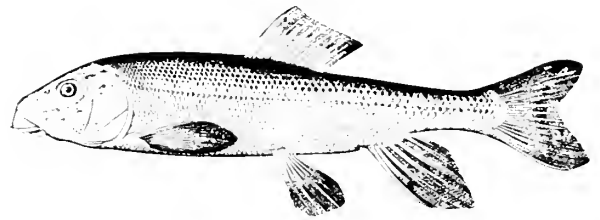
BIOLOGY: In MO adults in breeding condition collected over gravel riffles in late July (Pflieger 1975. *The Fishes of Missouri*). Vanicek (1961 Proc. Iowa Acad. Sci. 68: 238-46) studied comparative life history of this species and *C. carpio* in Des Moines River. Carlander (1969. *Handbook of Freshwater Fisheries Biology* Vol. 1) summarized age, length, and weight data. Beecher (1977. Abstr. 57th Ann. ASIH) compared ecology of *C. velifer* and *C. cyprinus* in FL.

Compilers: D. S. Lee and S. P. Platania.
June 1978.

Catostomous ardens Jordan and
Gilbert
Utah sucker

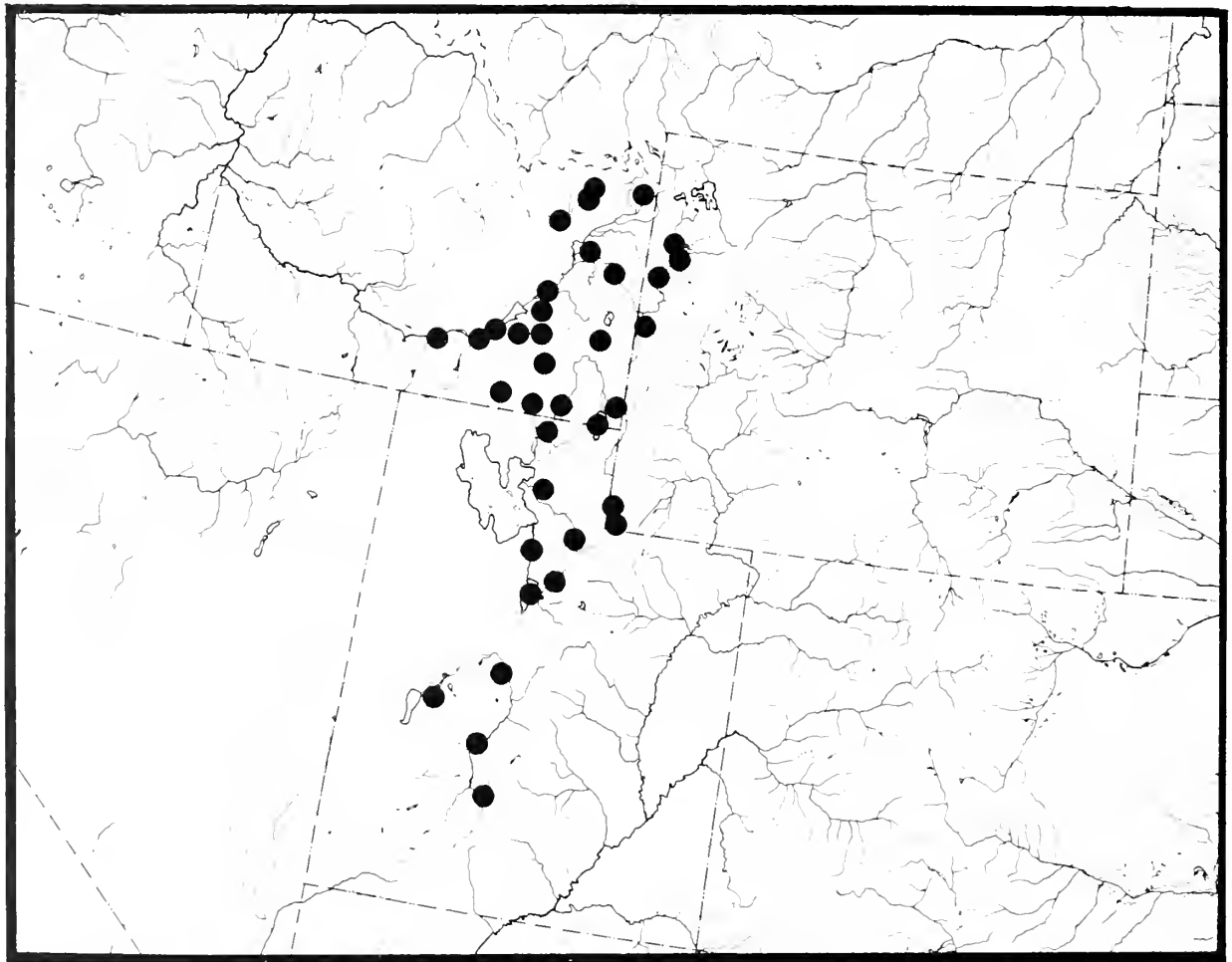
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Utah Lake, Utah Co.,
UT (Jordan and Gilbert 1881. Proc. U.S.
Natl. Mus. [1880] 3:459-64).



SYSTEMATICS: Smith and Koehn (1971.
Syst. Zool. 20:282-97) assigned it to sub-
genus *Catostomus* and analyzed specific re-
lationships. LaRivers (1962. *Fishes and
Fisheries of Nevada*) reviewed confusion of
names.

UT: Utah Lake (Jordan and
Evermann 1900).



DISTRIBUTION AND HABITAT: Ancient
Lake Bonneville basin of UT; WY, ID, and
NV, and Snake River system above Shoshone
Falls in ID and WY. Adaptable species, liv-
ing in lakes, reservoirs, rivers, and creeks
with slow to rapid current and at a variety
of temperatures (Miller 1952. Calif. Fish
Game 38:7-42). Abundant throughout range.

BIOLOGY: Bottom feeder, consuming both
plants and benthic animals (Baxter and
Simon 1970. *Wyoming Fishes*). Typically
spawns in May and June, in streams or along
shores of lakes over rocky areas (McConnell
et al. 1957. *Bear Lake. Its Fish and Fishing*).
Simon (1951. *Wyoming Fishes*) recorded de-
tails of spawning and Andreasen and Barnes
(1975. *Copeia*: 643-48) studied reproductive
life history.

ADULT SIZE: 250-350 mm SL.

Compiler: R. L. Wallace. July 1978.

Catostomus bernardini Girard
Yaqui sucker

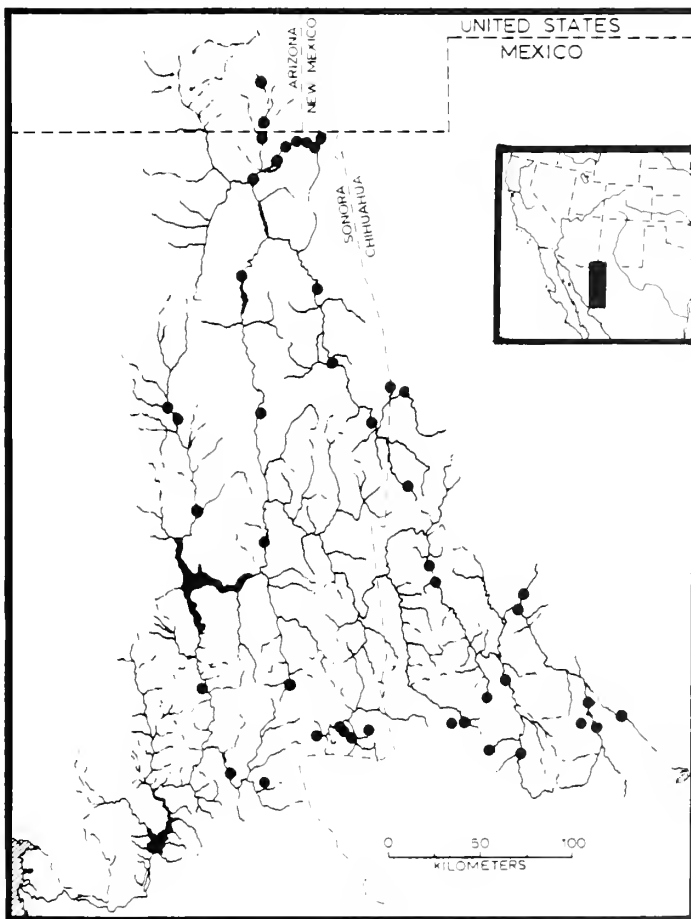
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Mexico, Sonora, Rio de San Bernardino, at United States — Mexican Boundary, ca. 29 km e Douglas, AZ, 31°20' N, 109°15' W (Girard 1857, Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213). Taylor (1967, Veliger 10:152-58) noted, however, that collections made during United States and Mexican Boundary Survey were on both sides of present border.

SYSTEMATICS: Subgenus *Catostomus*, as designated by Smith (1966, Misc. Publ. Mus. Zool. Univ. Mich. 129:1-132). Closely related to *C. insignis* of Gila and Bill Williams river systems and *C. conchos* of Rio Conchos basin, northern Mexico (Miller 1976, Fieldiana 69:1-31).



Mexico: Sonora, male, 127 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Restricted to Rio Yaqui basin, northwestern Mexico (Sonora and Chihuahua) and AZ. Recently extirpated from United States (Minckley 1973, *Fishes of Arizona*; McNatt 1974, Proc. West. Assoc. State Game Fish Comm. 54:273-79). Typically in deep pools, especially when large in size. Occurs in montane streams to elevations of more than 2,600 m, and in larger, mainstream systems lower than 160 m elevation. In AZ, inhabited channel of deeply incised San Bernardino Creek and headwater springs in characteristic pool habitat.

ADULT SIZE: To 400 mm.

BIOLOGY: Essentially unknown. Spawning is prolonged, from May through mid-August on basis of larvae and pro-larvae (original data; Branson et al. 1960, Copeia: 217-20). Breeding males become highly tuberculate on anal and caudal fins.

Compiler: W. L. Minckley, July 1979.

Catostomus catostomus (Forster)
Longnose sucker

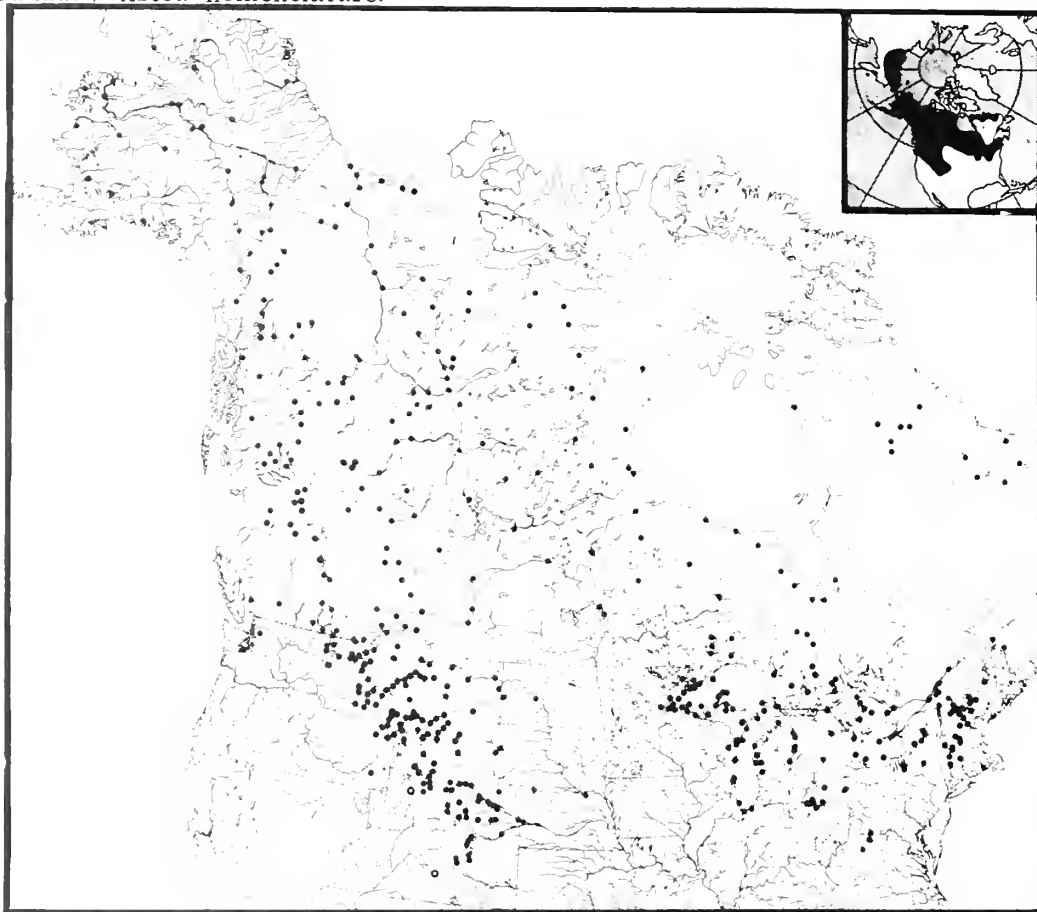
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Tributaries of Hudson Bay (Forster 1773. *Phila. Trans. Roy. Soc. London* 63:149-60).

SYSTEMATICS: Rather variable morphologically. Once thought to consist of a number of subspecies, and semidistinct dwarf forms known from various portions of range. McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*) described two morphological forms in Canada. Scott and Crossman (1973. *Freshwater Fishes of Canada*) listed nomenclature.



MD: Garrett Co., Lake Koshare (NCSM).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Western Labrador and QU south to western MD, west and north to MN, WA, and AK. Present in Arctic drainages of eastern Siberia (Yana, Kolyma, and Anadyr rivers). Most widespread sucker in north and found in relatively large numbers in most clear, cold waters. Farther south is more sporadic, and at extreme southern limits of range appears as glacial relict and semirelict populations. Reported at depths up to 183 m in Lake Superior.

ADULT LENGTH: Varies according to locality, some populations being dwarfed; maximum recorded length 643 mm TL.

BIOLOGY: Bailey (1969. *J. Fish. Res. Board Can.* 26:1289-99) studied age, growth, and

maturity in Lake Superior. Harris (1962. *J. Fish. Res. Board Can.* 19:113-26) and Geen et al. (1966. *J. Fish. Res. Board Canada* 23:1761-88) compiled biological summaries which appear in Scott and Crossman (1973). Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) summarized previous literature and compiled age, length, and weight data. Spawns at temperatures as low as 5°C, usually from mid-April to mid-May, and moves into streams in large numbers during spawning runs. Maximum life span usually about 10 years, but may live almost twice that (Harris 1962). Food is bottom invertebrates.

Compilers: C. R. Gilbert and D. S. Lee.
February 1978.

Catostomus clarki Baird and Girard
Desert sucker

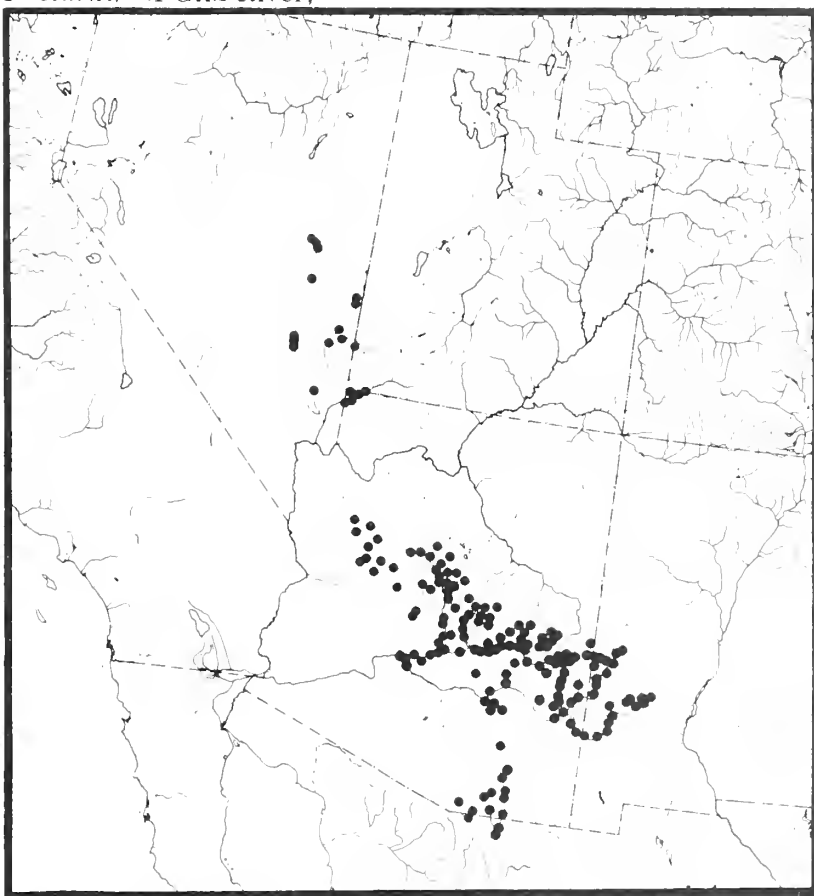
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Santa Cruz River, AZ (Baird and Girard 1854. Proc. Acad. Nat. Sci. Phila. [1854-55] 7:24-29).

SYSTEMATICS: Subgenus *Pantosteus*, according to Smith (1966. Misc. Publ. Mus. Zool. Univ. Mich. 129:1-132). Minckley (1973. *Fishes of Arizona*) gave reasons for rejecting Smith's (1966) synonymization of *Pantosteus* with *Catostomus* (see also Miller 1976. Fieldiana 69:1-31), and considered *C. clarki*, as now constituted, a complex of *P. intermedius* (Tanner 1942. Great Basin Nat. 3:27-32), *P. utahensis* (Tanner 1932. Copeia:135-36) and at least one undescribed form from Bill Williams River, AZ, plus true *P. clarki*, of Gila River, AZ.



AZ: Maricopa Co., Salt River
at Granite Reef Dam, 212 mm
SL (W. L. Minckley).



DISTRIBUTION AND HABITAT: Lower Colorado River basin downstream from Grand Canyon (Smith 1966), including Pluvial White River and Meadow Valley Wash, NV, Virgin River basin, UT, AZ, and NV, Bill Williams River basin, AZ, and Gila River drainage, AZ, NM, and north Sonora, Mexico. Characteristic of small to moderately large streams with pool-riffle development, occupies riffle areas when small in size. Large adults in pools during day, moving to riffles and rapids at night and in periods of high turbidity (Minckley 1973). Generally common.

ADULT SIZE: ca. 330 mm maximum.

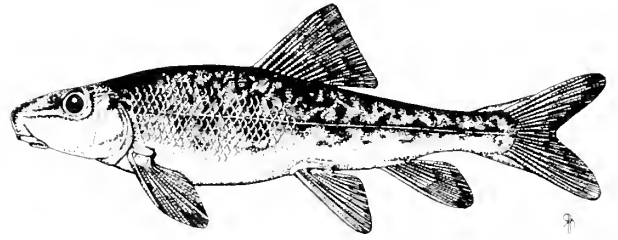
BIOLOGY: Herbivorous, feeding on encrusting diatoms and other algae scraped from stones and other surfaces by cartilage-sheathed jaws (Schreiber 1978. M.S. thesis, Arizona State Univ.). Spawns in winter and spring in AZ (January-May), with maturation occurring in third summer (Minckley 1973).

Compiler: W. L. Minckley. July 1979.

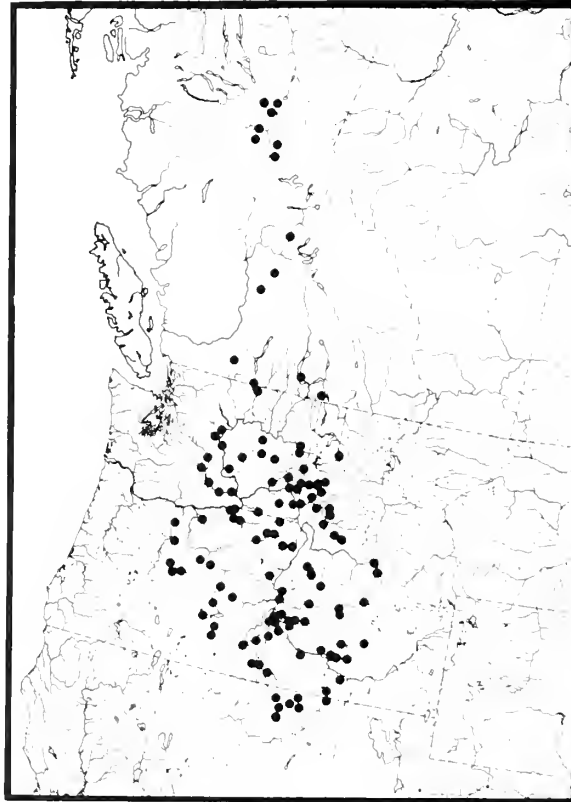
Catostomus columbianus (Eigenmann
and Eigenmann)
Bridgelip sucker

Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Boise River at Caldwell, OR [=Canyon Co., ID] (Eigenmann and Eigenmann 1893. *Am. Nat.* 27:151-54).
SYSTEMATICS: Originally described as *Pantosteus columbianus*. Taxonomy reviewed by La Rivers (1962. *Fishes and Fisheries of Nevada*). Miller and Miller (1948. *Copeia*: 174-87) transferred it to *Catostomus*. Smith (1966. *Misc. Publ. Mus. Zool. Univ. Mich.* 129:1-132) considered *C. columbianus* to belong to subgenus *Pantosteus* and proposed three subspecies. Smith and Koehn (1971. *Syst. Zool.* 20:282-97) subsequently presented new data indicating placement in subgenus *Catostomus* was perhaps correct, and analyzed species' interspecific relationships. Related to *C. arenatus* of Pliocene Lake Idaho (Smith 1978. in *Intermountain Biogeography: A symposium. Great Basin Memoirs*).



(NCSM)



Map modified from Smith 1966

DISTRIBUTION AND HABITAT: Restricted to fresh waters of northwestern North America, including Fraser River in BC, Columbia River drainages in ID, NV, OR, WA, and BC, (but below Shoshone Falls on Snake River) and Harney basin in eastern OR. Typically in smaller, more rapid flowing streams than sympatric members of genus *Catostomus* (Miller and Miller 1948).

ADULT SIZE: 120-200 mm SL, 250 mm SL maximum.

BIOLOGY: No definitive studies. Presumably feeds by scraping algae from rocks. Feeds on periphyton, detritus, and sometimes small invertebrates (Smith 1966). Spawns in spring. Limited growth and maturity data presented by Scott and Crossman (1973. *Freshwater Fishes of Canada*) and Smith (1966).

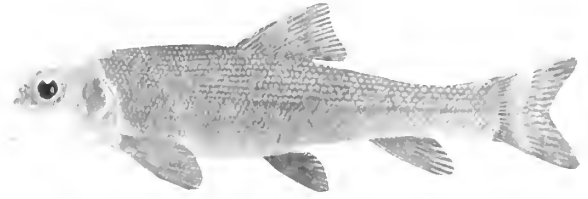
Compiler: R. L. Wallace. July 1978.

***Catostomus commersoni* (Lacepede)**
White sucker

Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: None given (Lacepede 1803. *Histoire Naturelle des Poissons* 5:1-803).

SYSTEMATICS: No comprehensive analysis of systematics over entire range published, although numerous dwarf populations have received individual recognition (McPhail and Lindsey 1970. *Freshwater Fishes of North-western Canada and Alaska*). Beamish and Crossman (1971. *J. Fish. Res. Board Can.* 34:371-78) concluded dwarf form *C. commersonii utawana* not valid subspecies. Metcalf (1966. *Univ. Kans. Publ. Mus. Nat. Hist.* 17:23-189) suggested that three geographical forms from eastern, Plains, and Hudson Bay drainages existed in past.



MD: Frederick Co., Glade Creek, 96 mm SL (NCSM).



See map on next page

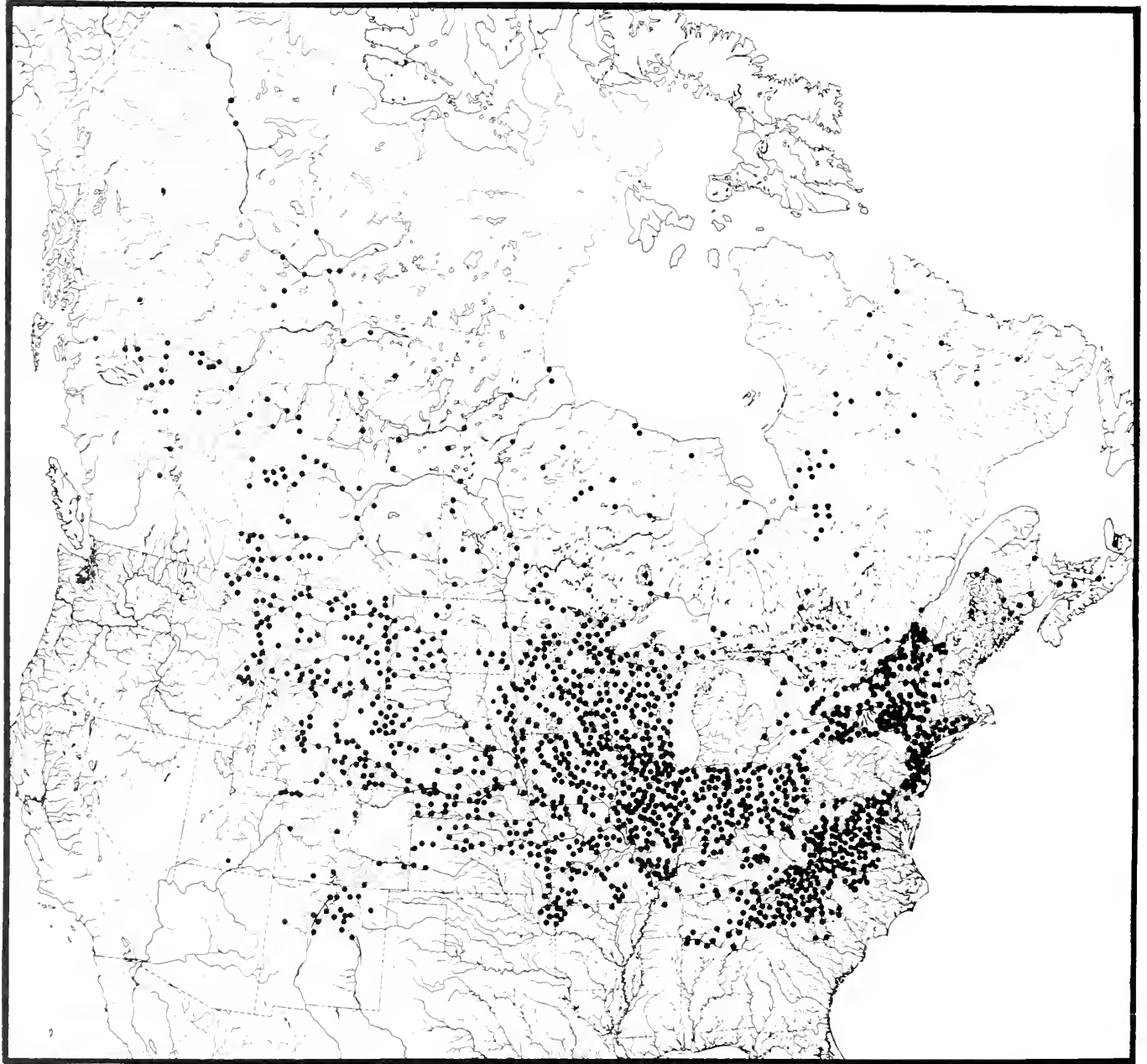
DISTRIBUTION AND HABITAT: Wide ranging, from Arctic Circle (in MacKenzie River drainage) south to NM and GA. Absent from most Pacific slope drainages. Common in wide variety of habitats.

ADULT SIZE: 305-508 mm TL, 635 mm TL maximum.

BIOLOGY: Stewart (1927. *U. S. Bur. Fish. Bull.* [1926] 42:147-84), Geen et al. (1966. *J. Fish Res. Board Can.* 23:1761-88), and

Verdon (1977. *Rap. Soc. Energie de la Baie James*: 1-40) provided data on reproduction, growth, age, and food habits. Fish (1932. *Bull. U.S. Bur. Fish.* 47:293-398) and Mansueti and Hardy (1967. *Development of Fishes of the Chesapeake Bay Region*) described and illustrated eggs and early life stages. Migrate into gravel streams (or lake margins) to spawn in the spring. Apparently lives maximum of 12 years.

Compilers: D. S. Lee and S. T. Kucas. June 1978.



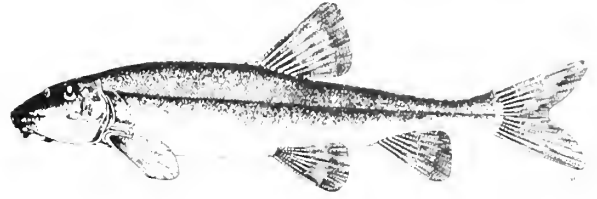
Distribution of white sucker, *Catostomus commersoni*

***Catostomus discobolus* Cope**
Bluehead sucker

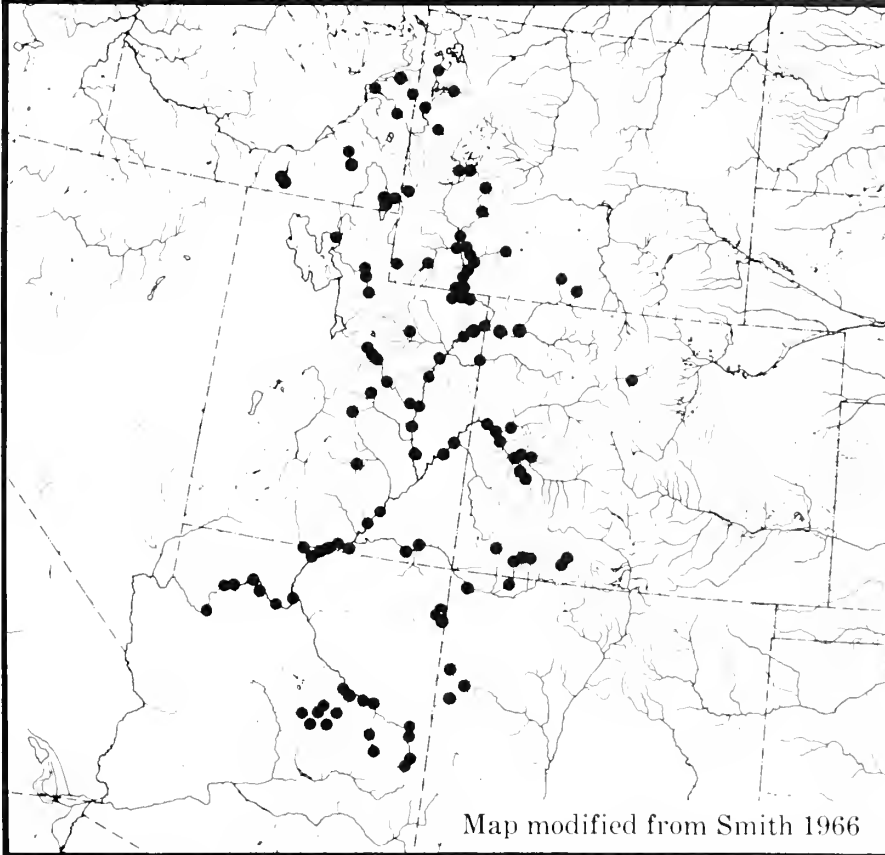
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Green River, WY (Cope 1872. Recent reptiles and fishes in U.S. Geological Survey of Wyoming and Contiguous territory. Special reports Part IV: 432-42).

SYSTEMATICS: Previously *Pantostus delphinus*. Smith (1966. Misc. Publ. Mus. Zool Univ. Mich. 129:1-132) placed it in *Catostomus* and determined the name *C. discobolus* had priority. Still regarded as a *Pantosteus* by some (e.g. Minckley 1973. *Fishes of Arizona*). Apparently most closely related to *C. clarki* (Smith and Koehn 1971. Syst. Zool. 20:282-97). Populations in Little Colorado River show introgression with *C. plebeius* from adjacent Rio Grande drainage (Smith 1966). Hybridizes with *C. latipinnis* and introduced *C. commersoni* in upper Colorado River basin (Holden and Stalnaker 1975. Trans. Am. Fish. Soc. 104:217-31).



AZ: Grand Canyon, Colorado River, male, 147 mm SL (NCSM).



Map modified from Smith 1966

DISTRIBUTION AND HABITAT: Throughout upper Colorado River drainage, replaced by *C. clarki* below Grand Canyon, AZ. Also in Bear and Weber river drainages (Pluvial Lake Bonneville basin) in ID, WY, and UT. Occupies wide variety of fluvial habitats, ranging from cold, clear trout streams (less than 20°C) to warm, very turbid streams. Prefers riffles over rocky substrate.

ADULT SIZE: 250-350 mm SL, 400 mm SL maximum.

BIOLOGY: Little known. Spawns during late spring or early summer in water at least 16°C. Scrapes organisms off rocks when feeding. Occasionally lives seven years.

Compilers: P.B. Holden and W. L. Minckley. March 1980.

Catostomus fecundus Cope and
Yarrow
Webbug sucker

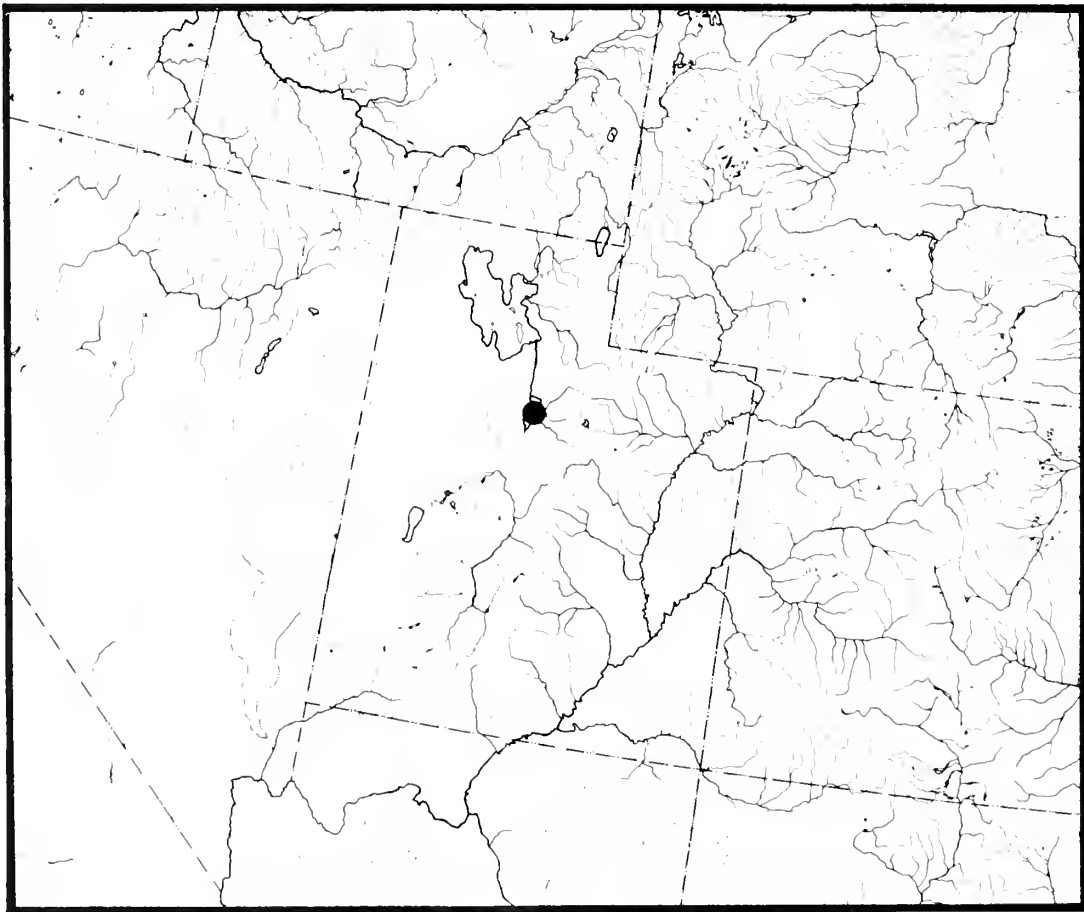
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Utah Lake, UT (Cope and Yarrow 1875. U.S. Army Engineer Department Report on the Geography and Geology of the Explorations and Surveys West of the 100th Meridian Vol. 5 [6]: 635-700).

ILLUSTRATION

NOT AVAILABLE

SYSTEMATICS: Although included by Bailey et al. (1970. Am. Fish. Soc. Spec. Publ. 6:1-149) in most recent checklist, status is still in doubt. Sigler and Miller (1963. *Fishes of Utah*) tentatively considered it hybrid between *Catostomus ardens* and *Chasmistes liorus*.



DISTRIBUTION AND HABITAT: Endemic to Utah Lake, UT.

BIOLOGY: Nothing known.

ADULT SIZE: Unreported.

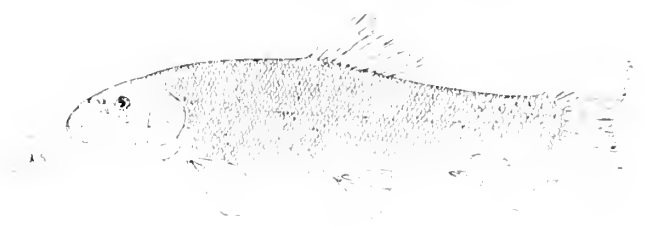
Compiler: F. C. Rohde. September 1978.

Catostomus fumeiventris Miller
Owens sucker

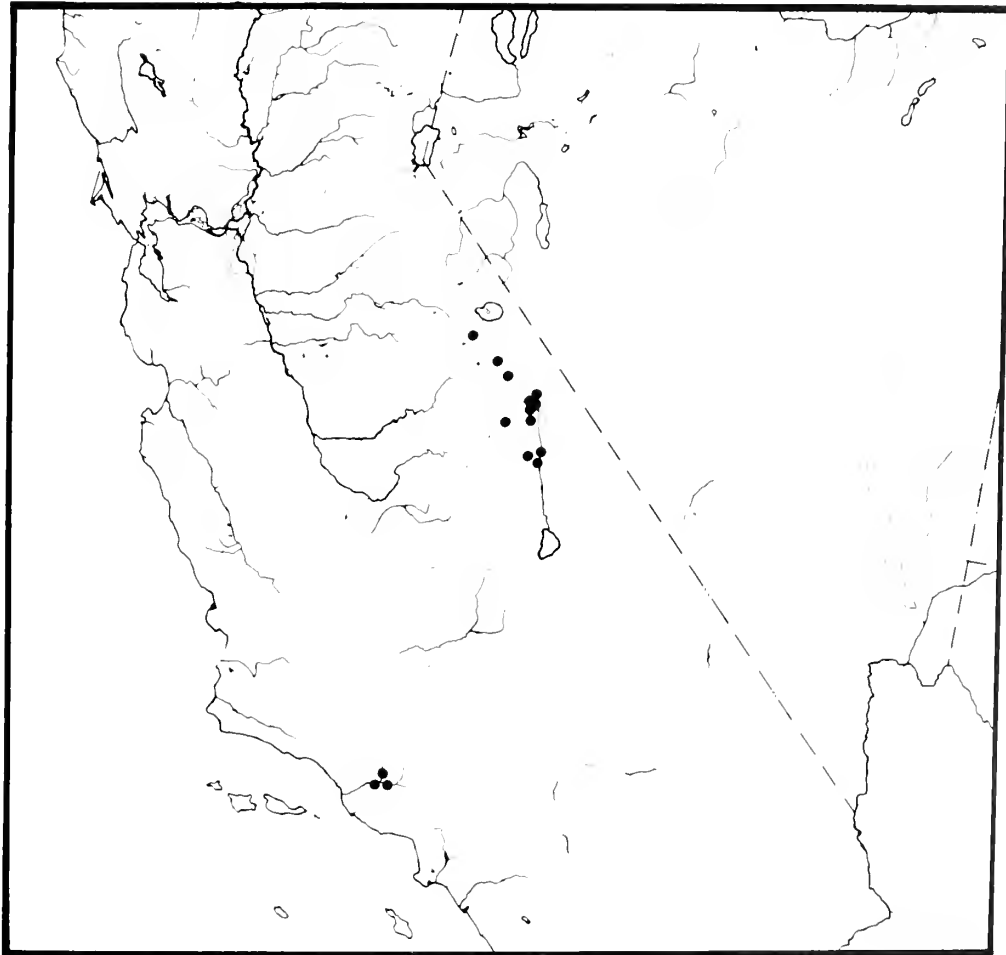
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Hilton Creek, tributary to Crowley Lake, Mono Co., CA (Miller 1973. Occas. Pap. Mus. Zool. Univ. Mich. 667:1-19).

SYSTEMATICS: Subgenus *Catostomus*. Closest relative is *C. tahoensis* (Miller 1973). Hybridizes with *C. (Pantosteus) santaanae* (Hubbs et al. 1943. Contrib. Lab. Vert. Biol. Univ. Mich. 22:1-76).



CA: Mono Co., Crowley Reservoir, 28 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Endemic to Owens River drainage and abundant where sufficient water available (Moyle 1976. *Inland Fishes of California*). Introduced to Santa Clara system via Los Angeles Aqueduct prior to 1939 (Bell 1978. Nat. Hist. Mus. Los Ang. Cty. Contrib. Sci. 295:1-20). Larvae abound in weedy edges and backwaters of streams (Miller 1973).

ADULT SIZE: 212-406 mm SL.

BIOLOGY: Little known, but presumably similar to *C. tahoensis*. Spawns late May through early July in Owens River and Crowley Lake (Moyle 1976), and in March in Santa Clara system. Development described by Miller (1973).

Compilers: D. G. Buth and R. W. Murphy.
March 1979.

Catostomus insignis Baird and Girard
Sonora sucker

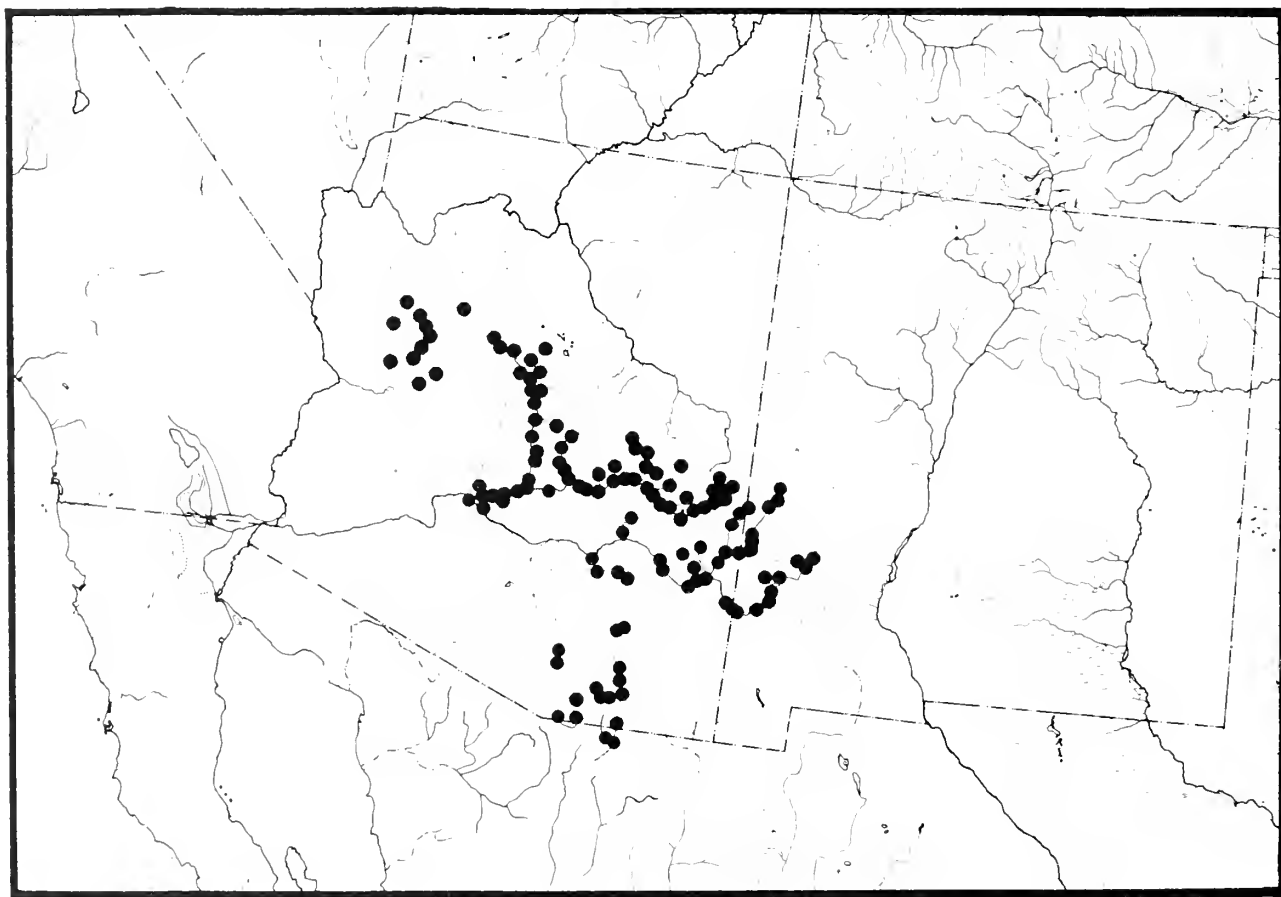
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: San Pedro River, probably near mouth of Babacomari River, Cochise Co., AZ (Baird and Girard 1854, Proc. Acad. Nat. Sci. Phila. [1854-55] 7:24-29).

SYSTEMATICS: Subgenus *Catostomus*, as designated by Smith (1966, Misc. Publ. Mus. Zool. Univ. Mich. 129:1-132). Closely related to *C. bernardini* of Rio Yaqui basin, northwestern Mexico.



NM: Grant Co., Gila River,
119 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Widely distributed and common between 300 and 2,000 m elevation in Gila and Bill Williams river basins of AZ and NM, and in headwaters of Santa Cruz and San Pedro rivers (Gila basin) in northern Sonora, Mexico. Widely extirpated in southern half of range, but overall common species. Characteristic of gravelly or rocky pools of creeks and rivers. Tends to remain near cover in daylight, but moves to runs and deeper riffles at night, especially when large in size (Minckley 1973, *Fishes of Arizona*).

ADULT SIZE: Commonly exceeds 400 mm TL; maximum ca. 800 mm.

BIOLOGY: Spawns February (sometimes January) through July; occasionally fails to successfully reproduce for one or more years. Feeds extensively on benthic invertebrates (Schreiber 1978, M.S. thesis, Arizona State Univ.), and seasonally on detrital material (Minckley 1973).

Compiler: W. L. Minckley, July 1979.

Catostomus latipinnis Baird and
Girard
Flannelmouth sucker

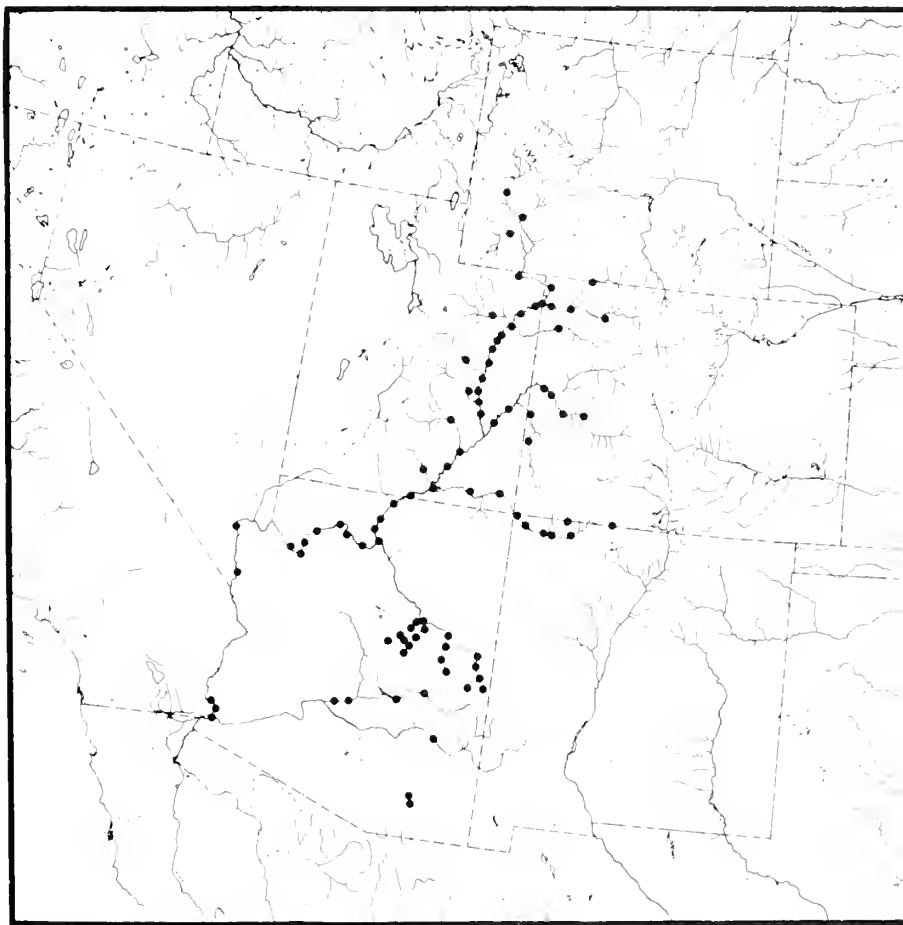
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: San Pedro River, AZ
(Baird and Girard 1854, Proc. Acad. Nat.
Sci. Phila. [1852-53] 6:387-90).

SYSTEMATICS: Subgenus *Catostomus*.
Principal species of this subgenus in Colorado
River basin. Although no systematic studies
are published, Smith and Koehn (1971, Syst.
Zool. 20:282-97) considered its closest affin-
ities with *C. macrocheilus*. Hybridizes with
Xyrauchen texanus (Hubbs and Miller 1953,
Pap. Mich. Acad. Sci. Arts Lett. 38:207-33)
and with the introduced *C. commersoni* (Hold-
en and Stalnaker 1975, Trans. Am. Fish. Soc.
104:217-31). Minckley (1973, *Fishes of Ariz-
ona*) considered populations in Little Colorado
River to represent an undescribed species.



AZ: Gila River (Jordan and
Evermann 1900).



DISTRIBUTION AND HABITAT: En-
tire Colorado River basin in moderate to large
rivers; rarely in small creeks and absent in
impoundments. Typical of pools and deeper
runs and often entering mouths of small
tributaries.

ADULT SIZE: 300-400 mm SL, ca. 500 mm
TL maximum.

BIOLOGY: Little known. Spawns in spring
and early summer on riffles at temperatures
near 13°, generally over coarse gravel bot-
toms. Apparently omnivorous with diet rang-
ing from vegetation to bottom invertebrates
(Minckley 1973).

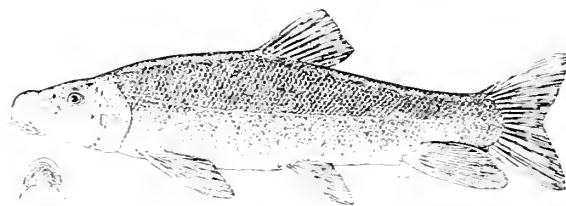
Compilers: W. L. Minckley and P. B. Holden.
March 1980.

Catostomus lucatus (Cope)
Lost River sucker

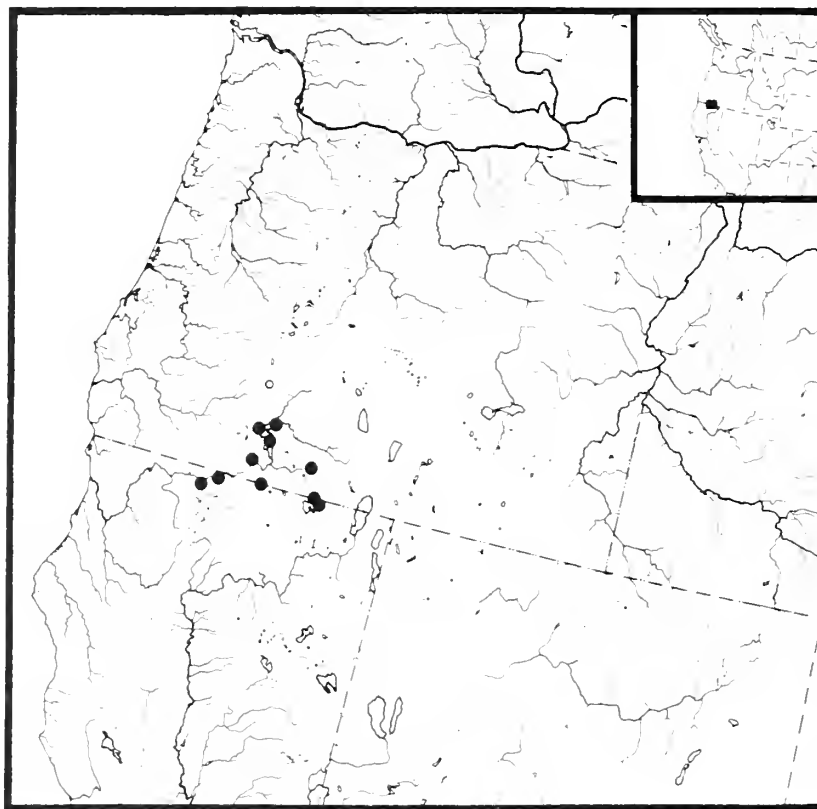
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Upper Klamath Lake, OR (Cope 1879. Am. Nat. 13:784-85).

SYSTEMATICS: Originally placed in *Chasmistes*, Seale (1896. Proc. Calif. Acad. Sci. [Ser. 2] 6:269) made it basis of genus *Deltistes*. Considered to be in *Catostomus* by Eigenmann (1891. Am. Nat. 25:667-68) and Miller (*in* Hubbs [ed.] 1958. Zoogeography Am. Assoc. Adv. Sci. Publ. 51:187-222). However, in description of two new fossil species, Miller and Smith (1967. Occas. Pap. Mus. Zool. Univ. Mich. 654:1-24) re-diagnosed *Deltistes* and recognized it as a genus. Hybridizes with *Chasmistes brevirostris* and *Catostomus snyderi*, especially with the latter (Andreasen 1975. Ph.D. diss., Oregon State Univ.; Moyle 1976. *Inland Fishes of California*).



CA : Modoc Co., Clear Lake Reservoir, 38 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Upper Klamath and Agency lakes, OR and lower parts of major tributaries; Clear Lake Reservoir, CA, Lost River, OR and CA, Klamath River and Copco Reservoir, CA. Lives in lakes or deep, quiet waters of rivers except in spawning migration.

ADULT SIZE: 40-70 cm SL.

BIOLOGY: Spawns in spring, in and along shore of Upper Klamath Lake as well as in swift, rubble-bottomed stretches of rivers. Andreasen (1975) noted that spawning run to rivers begins in late March when

river temperatures reach 5.5°C. Spawning peaks during first two weeks of April. In spring areas, where water may be constant 15.5°C, spawning can begin late February or early March. Females 574 to 646 mm SL carry from 102,000 to 231,000 eggs. Andreasen (1975) found spawners ranged in age from 5 to 18 annuli. Moyle (1976) mentioned spawning in March, April, and May, and that juveniles move immediately to lakes.

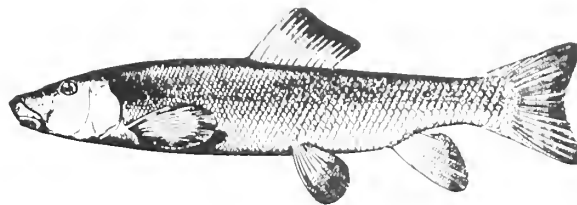
Compilers: C. E. Bond and K. M. Howe.
June 1979.

Catostomus macrocheilus Girard
Largescale sucker

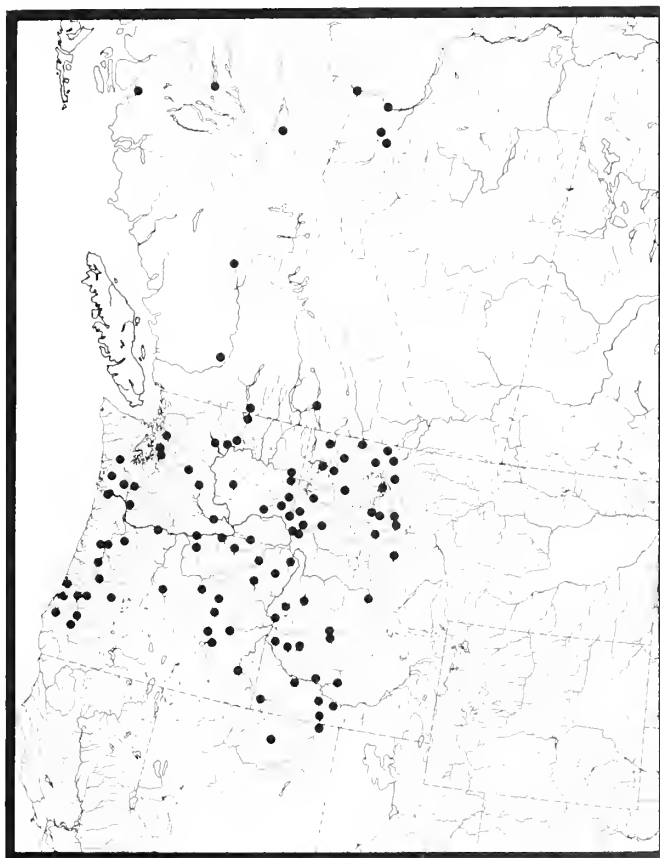
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Columbia River, at Astoria, OR (Girard 1857. Proc. Acad. Nat. Sci. Phila. [1856] 8:165-213).

SYSTEMATICS: Subgenus *Catostomus* (Smith and Koehn 1971. Syst. Zool. 20:282-97). Appears to be western counterpart to *C. commersoni*. Nelson (1968. J. Fish Res. Board Can. 25:101-50) analyzed hybridization between these where sympatric in BC. *Catostomus ardens* is sister species of *C. macrocheilus* (Smith 1978. in Intermountain biogeography: A symposium. Great Basin Memoirs).



OR: Tsiltcoos Lake, 20 cm
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Western North America, primarily west of Rocky Mountains, from Nass River, BC, south to Sixes River, OR, and from western MT to the coast. In Columbia River drainage below Shoshone Falls in ID and NV, and Harney Basin of eastern OR. Has penetrated east of Continental Divide in upper Peace River in BC downstream to junction of Smokey River in AT (McPhail and Lindsey 1970. *Freshwater Fishes of Northwestern Canada and Alaska*). Prefers slower-moving portions of larger rivers and streams (Miller and Miller 1948. Copeia: 174-87). Also in lakes (McPhail and Lindsey 1970).

ADULT SIZE: 200-300 mm SL, 610 mm TL maximum.

BIOLOGY: Spawns in spring typically in rivers at temperatures of at least 7.8° to 8.9°C. Females deposit demersal, adhesive eggs on sand or gravel (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Young pelagic, with terminal mouth until about 16 to 18 mm (Scott and Crossman 1973; McPhee 1960. Copeia:119-25). Omnivorous species whose diet includes plant material and variety of small invertebrates (Carl 1936. J. Biol. Can. 3:20-25; Clemens et al. 1939. Fish. Res. Board Can. Bull. 56:1-70). Calculated to live as long as 15 years, but age determinations after five years are difficult.

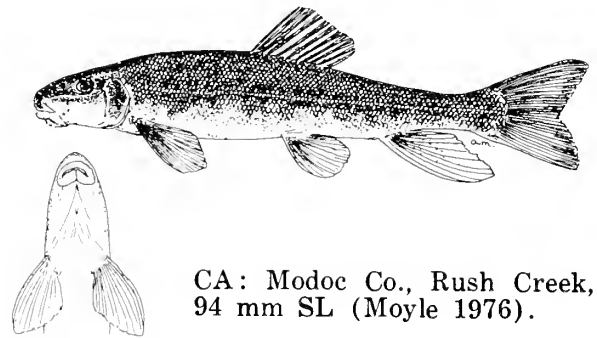
Compiler: R. L. Wallace. July 1978.

***Catostomus microps* Rutter**
Modoc sucker

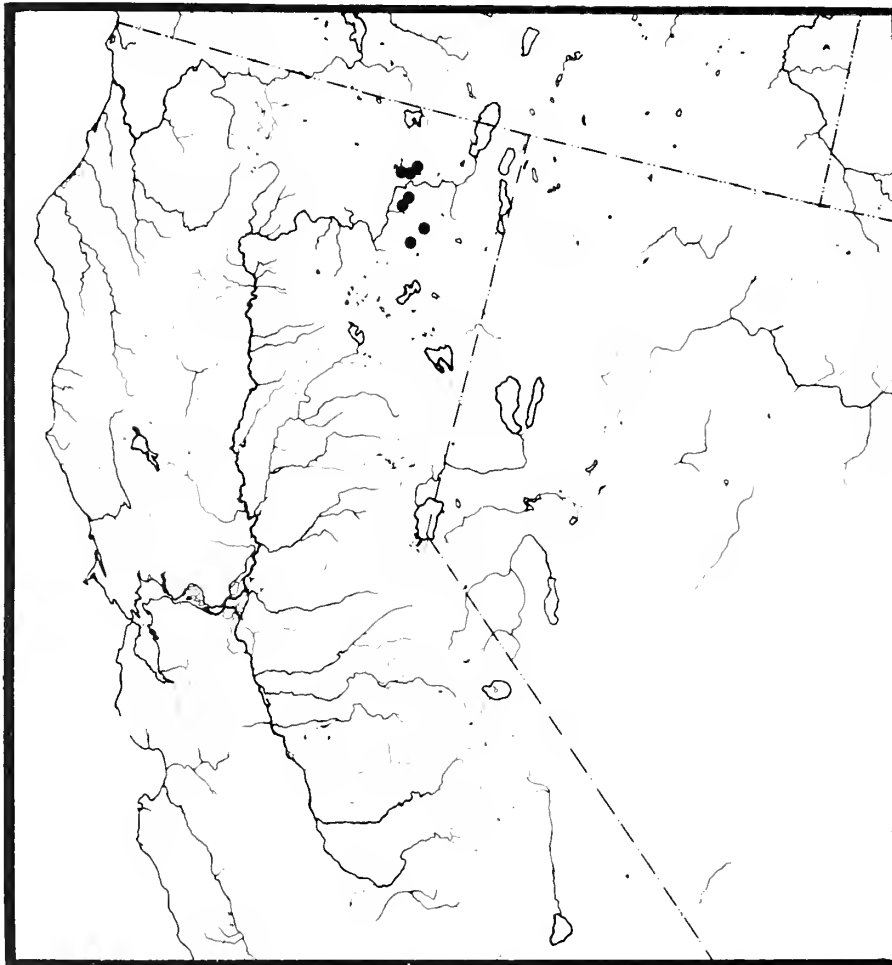
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Rush Creek near Adin, Modoc Co., CA (Rutter 1908. Bull. U.S. Bur. Fish. 27:103-52).

SYSTEMATICS: Probably closely related to Tahoe sucker, *C. tahoensis*.



CA: Modoc Co., Rush Creek,
94 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: In three small tributary systems to Pit River: Ash Creek (including Rush Creek), Turner Creek, and Willow Creek. Only in cool streams with low summer flows and large, shallow, muddy-bottomed pools. Rare in channelized sections (Moyle 1976. Calif. Fish Game 62:179-86).

BIOLOGY: Typical of genus *Catostomus*, but mature in second or third year at about 120 mm SL (Moyle and Marciochi 1975. Copeia:556-60). Proposed for endangered status because habitat destruction, predation by exotic *Salmo trutta*, and perhaps hybridization with *C. occidentalis*, have resulted in total population of less than 2,000 fish.

ADULT SIZE: 120-180 mm SL.

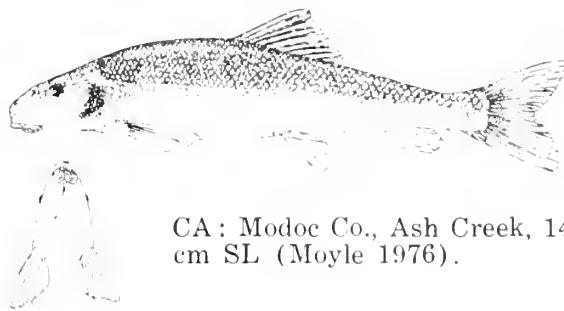
Compiler: P. B. Moyle. July 1978.

Catostomus occidentalis Ayres
Sacramento sucker

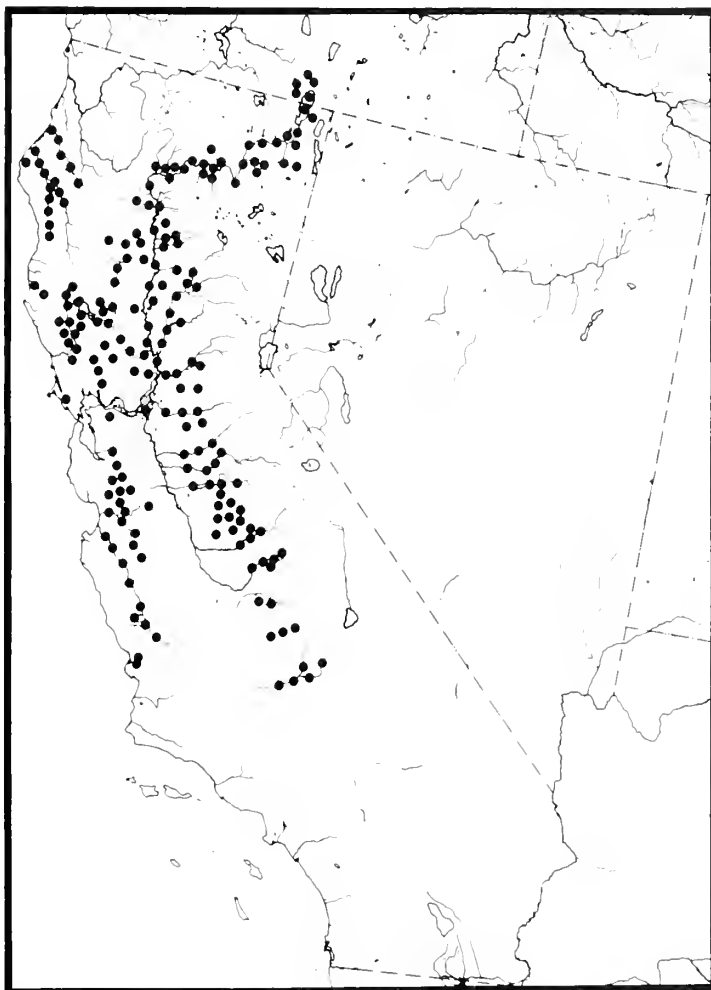
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: San Francisco Fish Market, but probably from Sacramento River (Ayres 1854. Daily Placer and Transcript, May 30. Repeated in 1857 Proc. Calif. Acad. Sci. [1854-57] 1:3-22).

SYSTEMATICS: Subgenus *Catostomus*. Four poorly defined subspecies described: *C. o. occidentalis* from Sacramento and San Joaquin river drainages; *C. o. mniotiltus* from Pajaro and Salinas rivers; *C. o. humboldtianus* from north coastal drainages; and *C. o. lacusanserinus* from Goose Lake, Modoc Co., CA (Snyder 1914. Bull. U.S. Bur. Fish. [1912] 32:49-72; 1908. Bull. U.S. Bur. Fish. 28:162-65; Fowler 1913. Proc. Acad. Nat. Sci. Phila. 65:45-60). Validity of all subspecies questionable.



CA: Modoc Co., Ash Creek, 14 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Widespread in streams and reservoirs of Sacramento-San Joaquin drainage and adjacent Pacific drainages, CA-OR. Adults require deep pools and are most abundant in clear, cool streams at moderate elevations (200 to 600 m).

ADULT SIZE: 200-500 mm SL.

BIOLOGY: Feeds on detritus, algae, and small invertebrates. Life history similar to other large *Catostomus* (Moyle 1976. *Inland Fishes of California*).

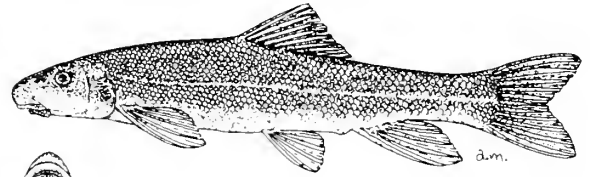
Compiler: P. B. Moyle. July 1978.

***Catostomus platyrhynchus* (Cope)**
Mountain sucker

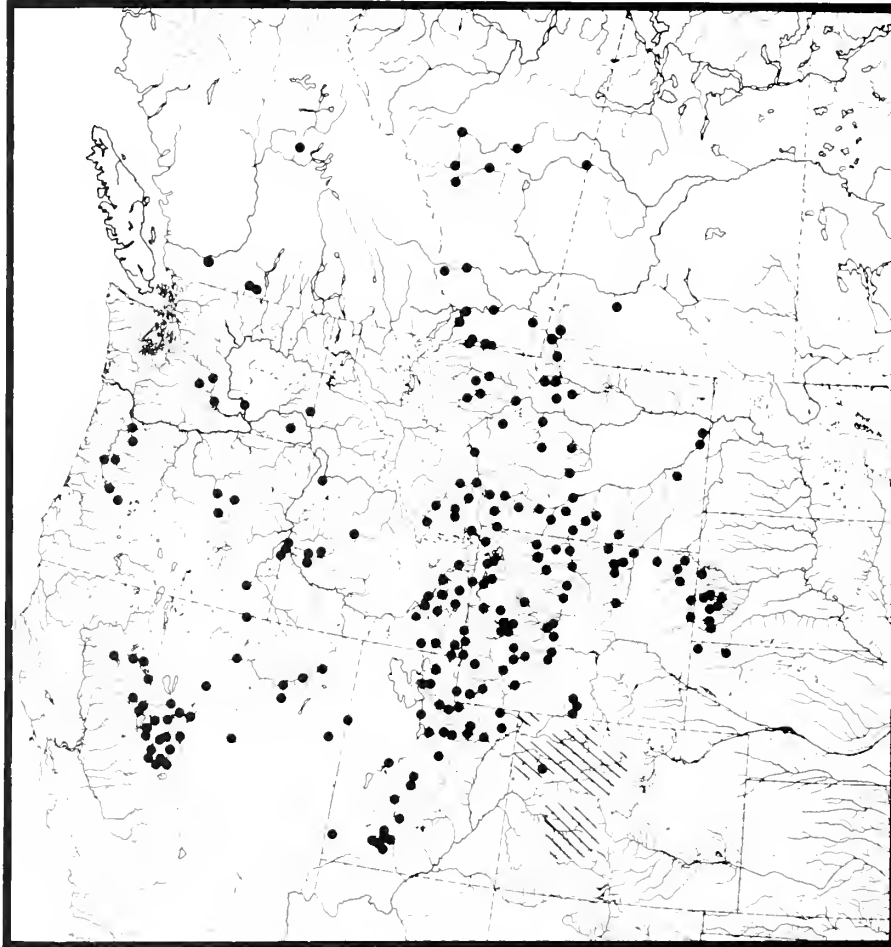
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: A tributary of Green River, WY (Cope 1871. Recent reptiles and fishes in U.S. Geological Survey of Wyoming and Contiguous territory [1870] Special reports Part IV:432-42.)

SYSTEMATICS: Subgenus *Pantosteus*. Long known as *P. jordani*. Confusing taxonomy reviewed by Smith (1966. Misc. Publ. Mus. Zool. Univ. Mich. 129:1-132), who reduced *Pantosteus* to subgenus of *Catostomus*, and reviewed species systematics. Hybridizes with *C. ardens*, *C. commersoni*, *C. discobolus*, and *C. tahoensis* (Smith 1966).



CA: Placer Co., Sagehen Creek,
11 cm SL (Moyle 1976).



Map modified from Smith 1966

DISTRIBUTION AND HABITAT: Mountainous western North America, in Pacific, Arctic (Saskatchewan River), and Atlantic (upper Missouri) drainages. Ranges from northeastern CA and NV north to southern BC, AT, and southwestern SA, south through MT, WY, and UT, and as far east as Black Hills in SD. Occupies wide variety of habitats, but usually prefers cool, clear streams. Occasionally in lakes (Baxter and Simon 1970. *Fishes of Wyoming*).
ADULT SIZE: 80-160 mm SL, 175 mm SL maximum.

BIOLOGY: Spawns late spring to early summer in streams. Omnivorous mainly on diatoms and algae, although some small invertebrates also taken (Smith 1966; Hauser 1969. Trans. Am. Fish. Soc. 98:209-15). Age and growth reported for a MT population (Hauser 1969). Maturity apparently attained at end of second and occasionally first year. Largest (175 mm SL) known individual appeared to be in fourth or fifth year (Smith 1966).

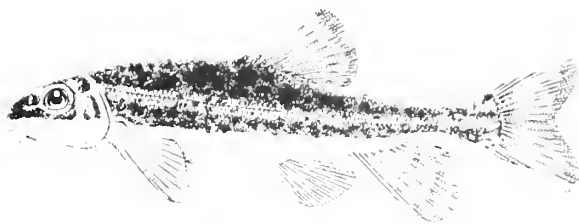
Compiler: R. L. Wallace. July 1978.

Catostomus plebeius Baird and Girard
Rio Grande sucker

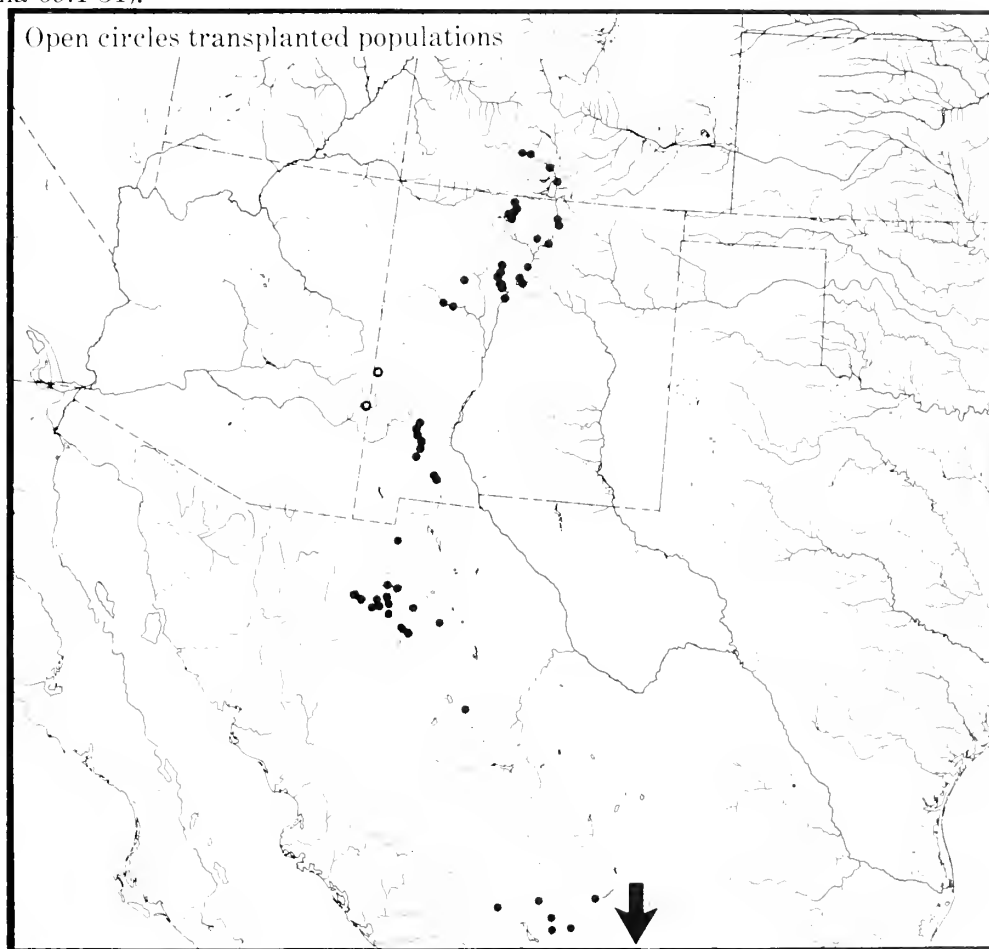
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Mimbres River, NM, tributary to Lago de Guzman, Chihuahua, Mexico (Baird and Girard 1854, Proc. Acad. Nat. Sci. Phila. [1854-55] 7:24-29).

SYSTEMATICS: Subgenus *Pantosteus*, Smith (1966, Misc. Publ. Mus. Zool. Univ. Mich. 129:1-132) synonymized *Pantosteus* as subgenus of *Catostomus*, largely on basis of intermediacy of *C. plebeius* (and *C. columbianus*) between more distinctive species of the two taxa. Minckley (1973, *Fishes of Arizona*) gave reasons for rejecting this interpretation (see also Miller 1976, Fieldiana 69:1-31).



NM: Grant Co., Mimbres,
male, 104 mm SL (NCSM).



Southern limits of range not shown

DISTRIBUTION AND HABITAT: Wide ranging from Rio Grande of CO and NM, south through intermontane basins and headwaters of Pacific drainages to Durango and Zacatecas, Mexico (Smith 1966); introduced into Gila River basin (Minckley 1973). Inhabits pools, runs, and riffles of small to moderately large streams. Rarely with other catostomid species except in high elevation brooks in Mexico (Rio Yaqui drainage; original data).

ADULT SIZE: 60-90 mm, rarely exceeding 140 mm.

BIOLOGY: Spawns February through April, and may extend into summer. Koster (1957, *Guide to the Fishes of New Mexico*) suggested spring and autumn spawning. Foods in northern populations are diatoms, detrital materials, and benthic invertebrates. Biology in Mexico unknown.

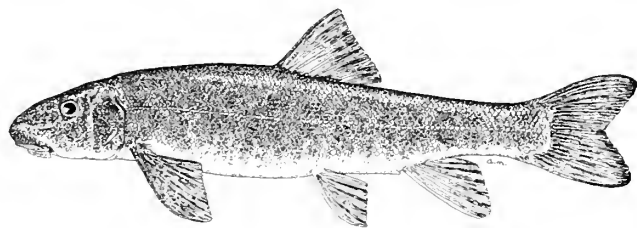
Compiler: W. L. Minckley, July 1979.

Catostomus rimiculus Gilbert and
Snyder
Klamath smallscale sucker

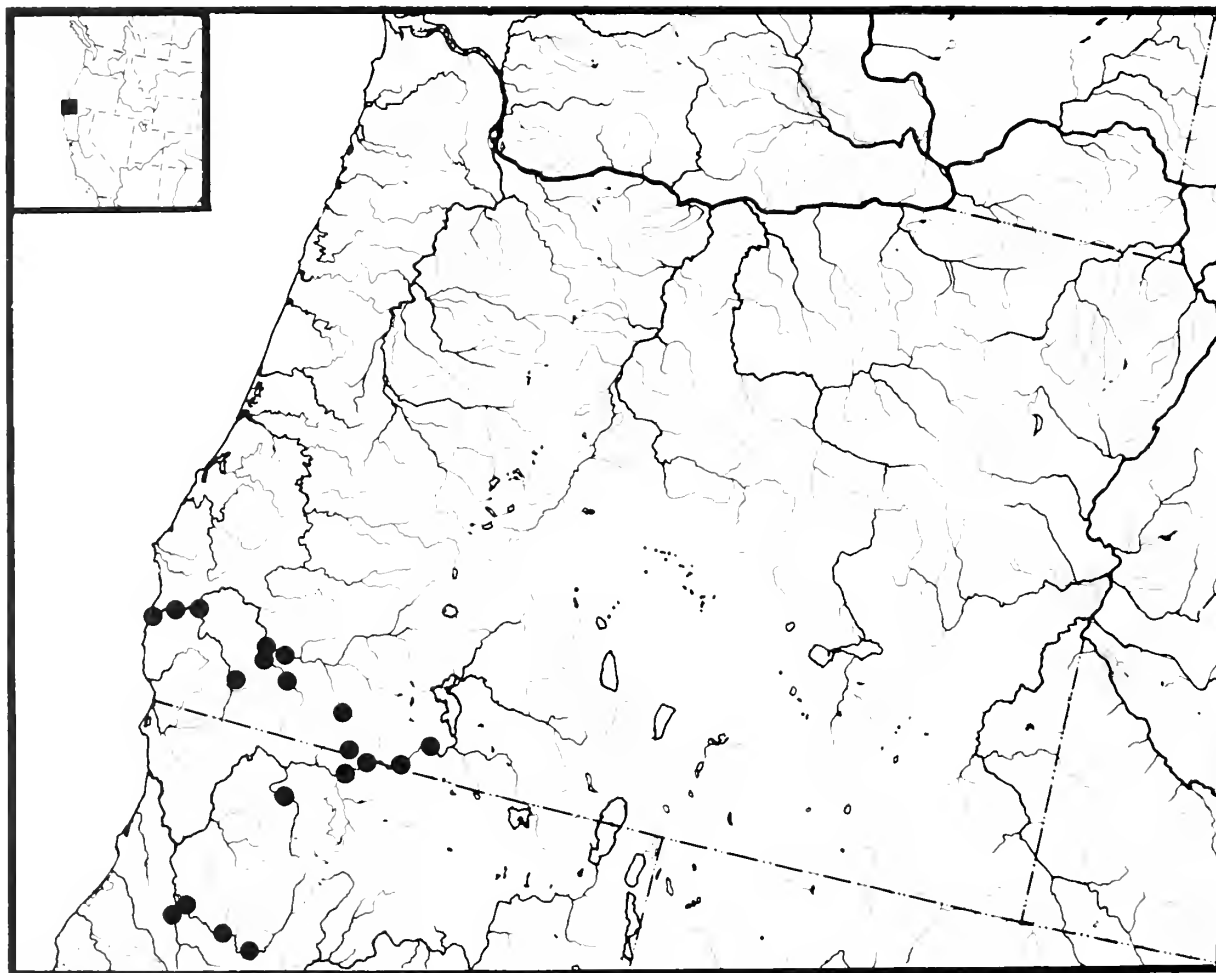
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Trinity River, Hoopa Valley, Humboldt Co., CA (Gilbert and Snyder in Gilbert 1898. Bull. U.S. Fish. Comm. 17:3).

SYSTEMATICS: Subgenus *Catostomus*. Closely related to *C. catostomus* (Smith 1966. Misc. Publ. Mus. Zool. Univ. Mich. 129:1-132; Smith and Koehn 1971. Syst. Zool. 20:282-97). Snyder (1908. Bull. U.S. Bur. Fish. 27:153-89) reported only minor differences between Klamath and Rogue river stocks.



CA: Siskiyou Co., Scott River,
18 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Klamath River below the falls, Trinity and Rogue rivers, OR and CA. Moyle (1976. *Inland Fishes of California*) reported habitat as pools of large streams and slow-moving stretches of small streams.

ADULT SIZE: 410 mm SL maximum.

BIOLOGY: Moyle (1976) mentioned presumed spring spawning migration to tributaries and reported slow growth. Maximum age nine years.

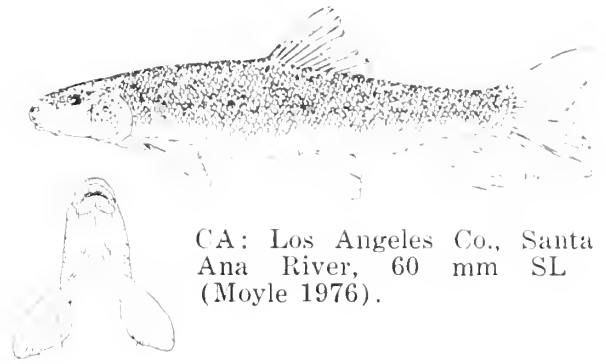
Compilers: C. E. Bond and K. M. Howe.
June 1979.

Catostomus santaanae (Snyder)
Santa Ana sucker

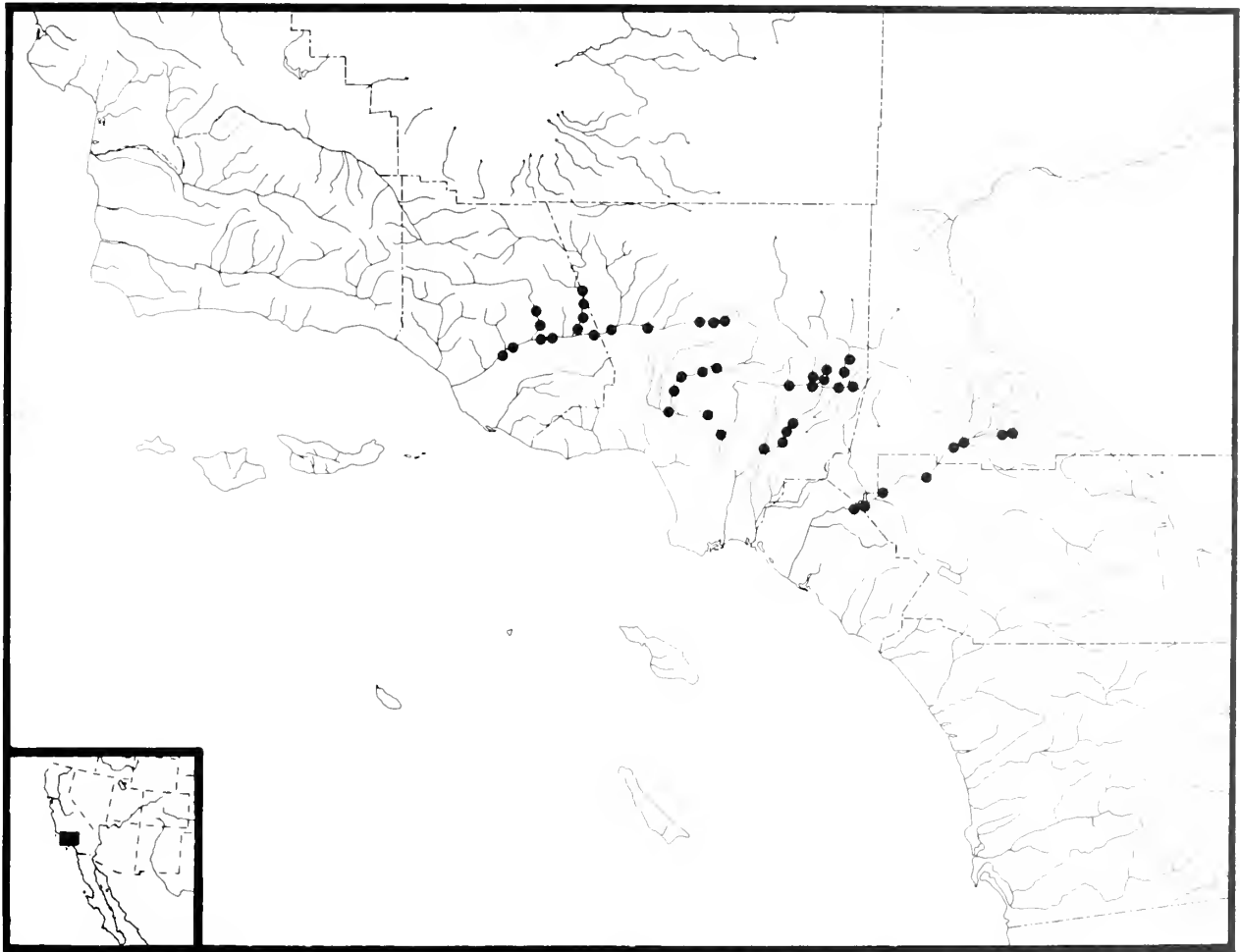
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Santa Ana River, near Riverside, Riverside Co., CA (Snyder 1908. Proc. U.S. Natl. Mus. 34:33-34).

SYSTEMATICS: Subgenus *Pantosteus*. Smith (1966. Misc. Publ. Mus. Zool. Univ. Mich. 129:1-132) studied systematics.



CA: Los Angeles Co., Santa Ana River, 60 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Native to Los Angeles, San Gabriel, and Santa Ana river systems of southern CA; introduced into Santa Clara River. Clear, cool, rocky and gravelly streams in areas of moderate gradient (Smith 1966). Apparently common throughout range.

ADULT SIZE: 75-160 mm SL, 200 mm SL maximum.

BIOLOGY: In Santa Clara River breeds March to July, lives three to four years. Diet algae and diatoms, with aquatic insects a minor component. Hybridizes with *Catostomus* (*Catostomus*) *fumeiventris* (also introduced) in Santa Clara River (Greenfield et al. 1970. Calif. Fish Game 56:166-79; Moyle 1976. *Inland Fishes of California*).

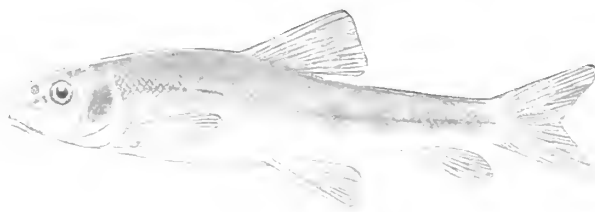
Compiler: C. C. Swift. January 1979.

Catostomus snyderi Gilbert
Klamath largescale sucker

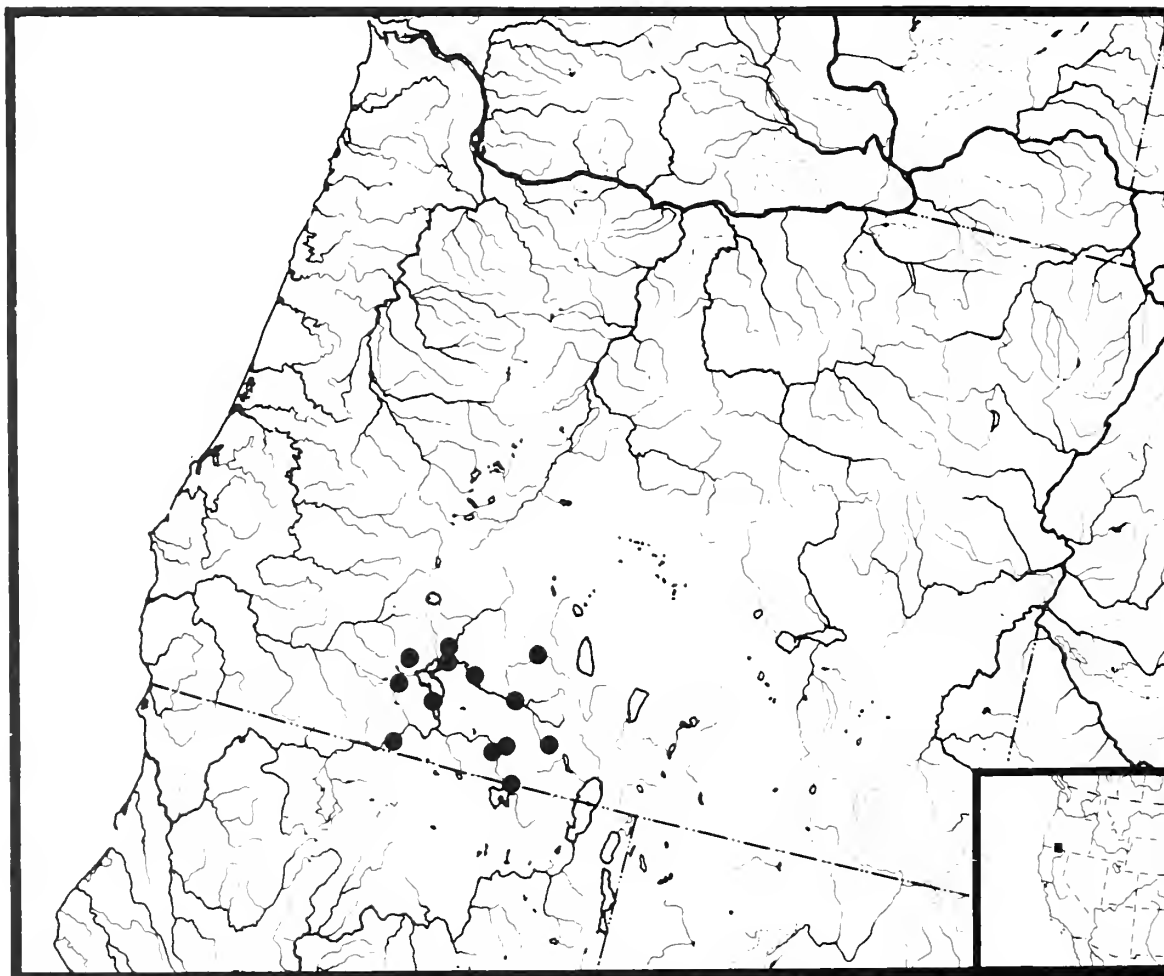
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Upper Klamath Lake, OR (Gilbert 1898. Bull. U.S. Fish. Comm. 17:1-13).

SYSTEMATICS: Subgenus *Catostomus*. Relationships considered by Smith and Koehn (1971. Syst. Zool. 20:282-97). Hybridizes with *C. luxatus* and *Chasmistes brevirostris*; strong introgression involving *C. brevirostris* noted in Lost River system, OR and CA (Andreassen 1975. Ph.D. diss., Oregon State Univ.).



(NCSM)



DISTRIBUTION AND HABITAT: Upper Klamath and Agency lakes and tributaries, OR, Clear Lake Reservoir, CA, and Lost River, CA and OR. Typically in large creeks and rivers.

ADULT SIZE: 300-450 mm SL.

BIOLOGY: Feeds on benthic organisms. Spawning migrations begin in March at about 5.5°C. Spawning usually extends late March to mid-April, earlier in streams fed by warm springs. Females of 353-421 mm SL carry 40,000 to 64,500 eggs (Andreassen 1975).

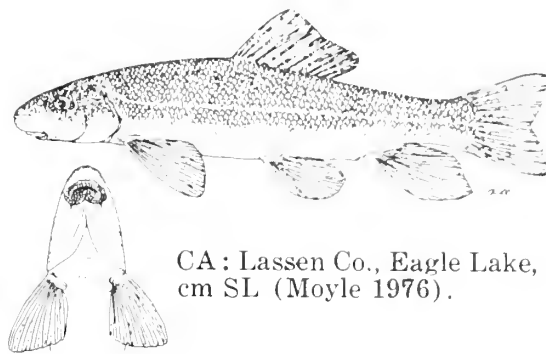
Compilers: C. E. Bond and K. M. Howe.
June 1979.

***Catostomus tahoensis* Gill and Jordan**
Tahoe sucker

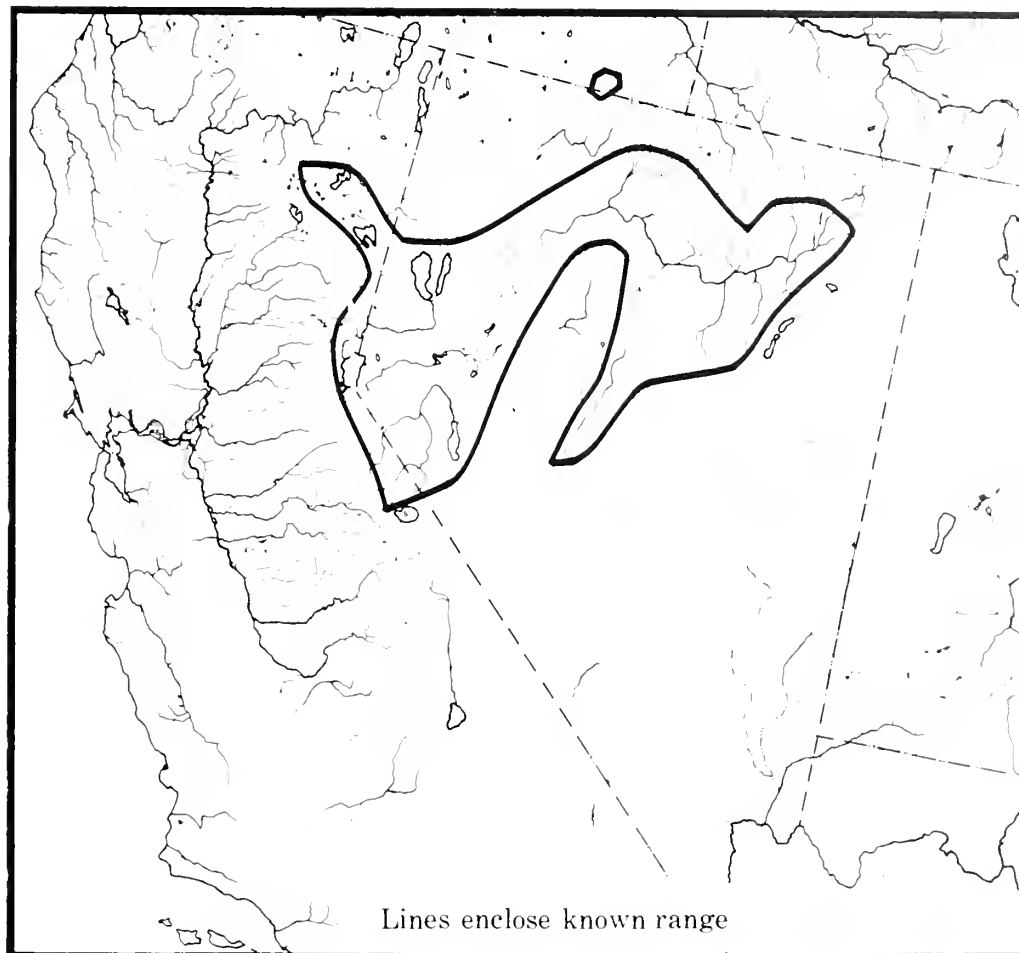
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Lake Tahoe, NV (Gill and Jordan *in* Jordan 1878. U.S. Natl. Mus. Bull. 12:97-237).

SYSTEMATICS: Subgenus *Catostomus*. Relationships to others of genus treated by Smith and Koehn (1971. Syst. Zool. 20:282-97). Hybridizes with *C. platyrhynchus* (Hubbs et al. 1943. Contrib. Lab. Vertebr. Biol. Univ. Mich. 22:1-76).



CA: Lassen Co., Eagle Lake, 21 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Throughout Lahontan drainage basin of northeastern CA and west-central NV, reaching southeastern OR. Abundant in streams of various sizes, reservoirs, and large lakes such as Tahoe, Pyramid, and Eagle. Typical *Catostomus* of Lahontan Basin.

BIOLOGY: Omnivorous, but may ingest many invertebrates during feeding, including insects and various crustaceans. Spawns late April to mid-June at temperatures of at least 11-14° C when individuals congregate in large numbers in riffle areas. May live up to 15 years (Moyle 1976. *Inland Fishes of California*).

ADULT SIZE: 200-350 mm SL.

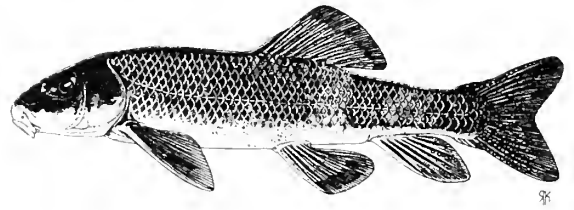
Compiler: P. B. Moyle. September 1978.

Catostomus warnerensis Snyder
Warner sucker

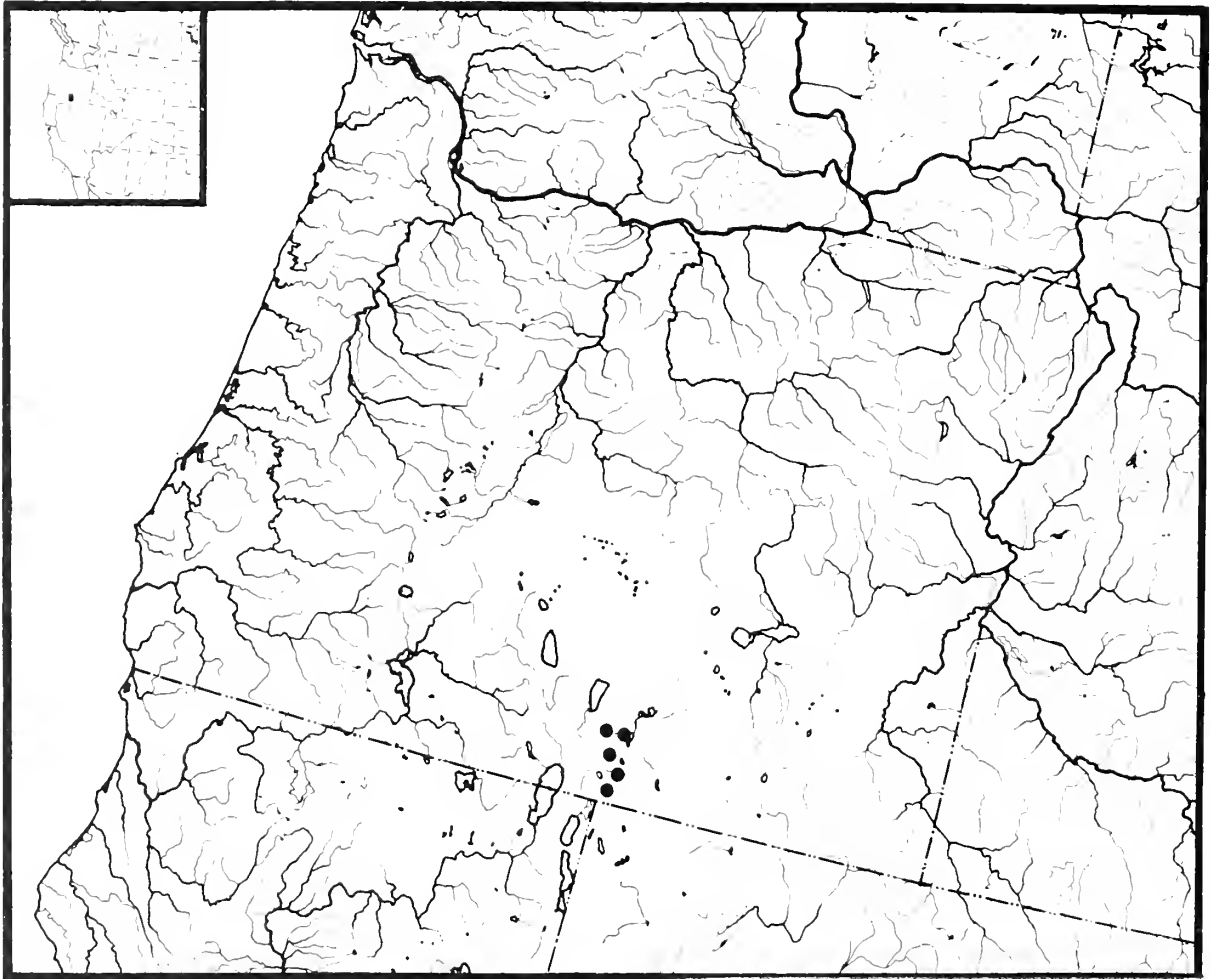
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: "Warner Creek, near Adel, Lake Co.," OR (Snyder 1908. Bull. Bur. Fish. 27:71-102). Now called Deep Creek.

SYSTEMATICS: Cope (1884. Proc. Acad. Nat. Sci. Phila. 35:134-66) first collected this species, but referred to it as *C. tahoensis*. Gilbert and Snyder (*in* Gilbert 1898. Bull. U.S. Fish. Comm. 17:1-13) referred Cope's *C. tahoensis* from Warner Lake to synonymy of *C. rimiculus* with a question mark. No other information available.



OR: Lake Co., Honey Creek,
271 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Confined to endorheic Warner Lake Basin of southeastern OR. Populations declining due to irrigation dams and canals, and introduction of predaceous game fishes. Populations known in Hart, Crump, and Pelican lakes, and some tributary systems.

BIOLOGY: Little known. Although thought to be lake dweller except during spawning, recent observations suggest separate (?) sub-populations existing in streams throughout life. Spawns in spring, and at least some young migrate immediately into lakes. Study of life history proposed to begin in 1979.

ADULT SIZE: ca. 15-35 cm TL.

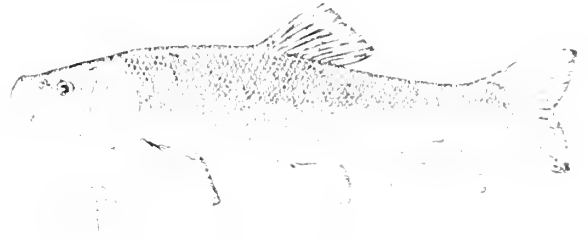
Compiler: K. M. Howe. July 1978.

Chasmistes brevirostris Cope
Shortnose sucker

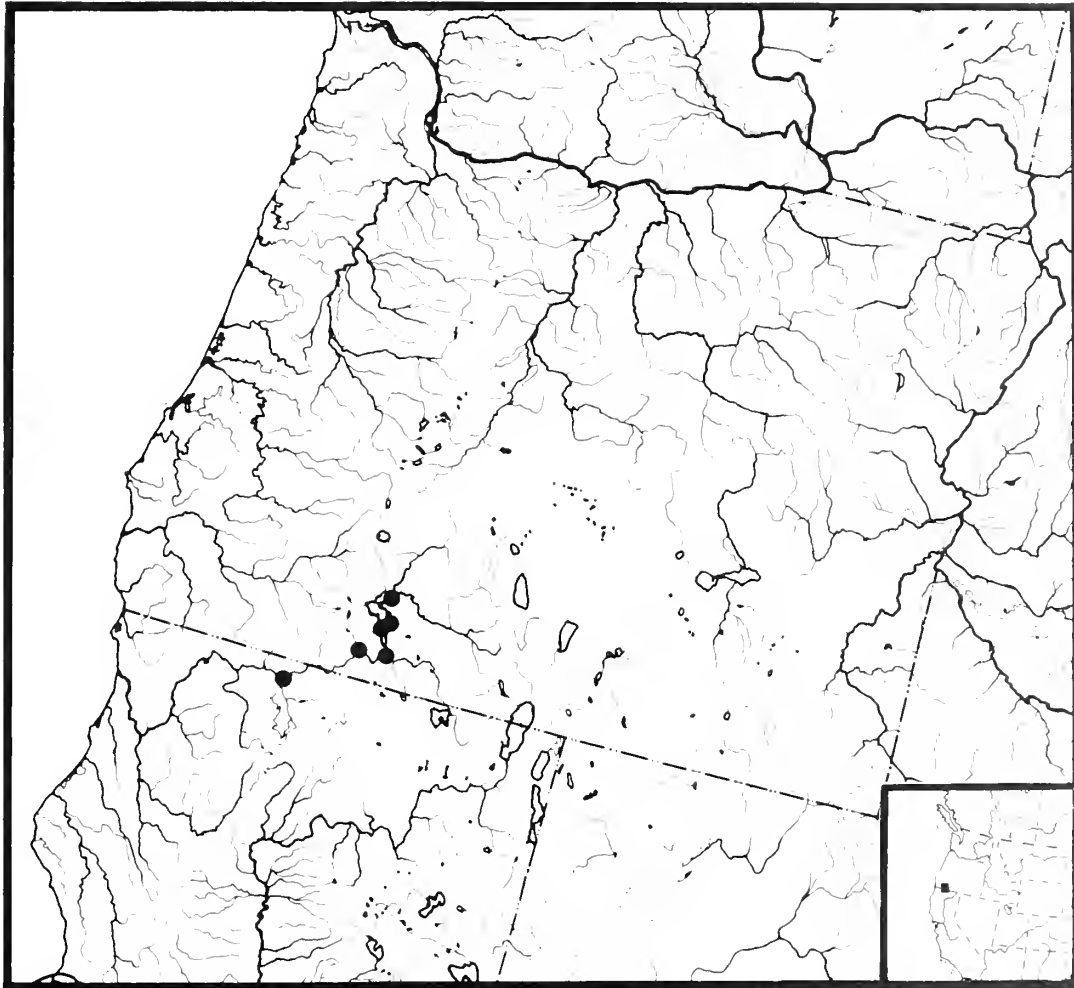
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Upper Klamath Lake, OR (Cope 1879. Am. Nat. 13:784-85).

SYSTEMATICS: Status clouded by lack of agreement in appearance between poorly preserved holotype and modern specimens. Introgressed by *Catostomus snyderi* in Lost River system, where only hybrids now known.



CA: Modoc Co., Clear Lake Reservoir, 38 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Upper Klamath and Agency lakes, OR and lower sections of tributaries. Klamath River, OR and CA, and Copco Reservoir, CA. Usually in still or slow waters except during spawning migration.

ADULT SIZE: 350-450 mm SL, ca. 500 mm SL maximum.

BIOLOGY: Zooplankton an important food component. Spawning migration to rivers occurs in April. Individuals in spawning condition found in swift current over gravel and rubble bottom. Females ranging from 351 to 465 mm SL contained from 34,000 to 72,500 eggs (Andreasen 1975. Ph.D. diss., Oregon State Univ.)

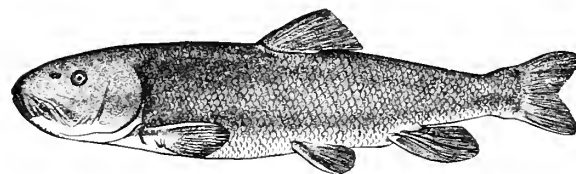
Compilers: C. E. Bond and K. M. Howe.
June 1979.

Chasmistes cujus Cope
Cui-ui

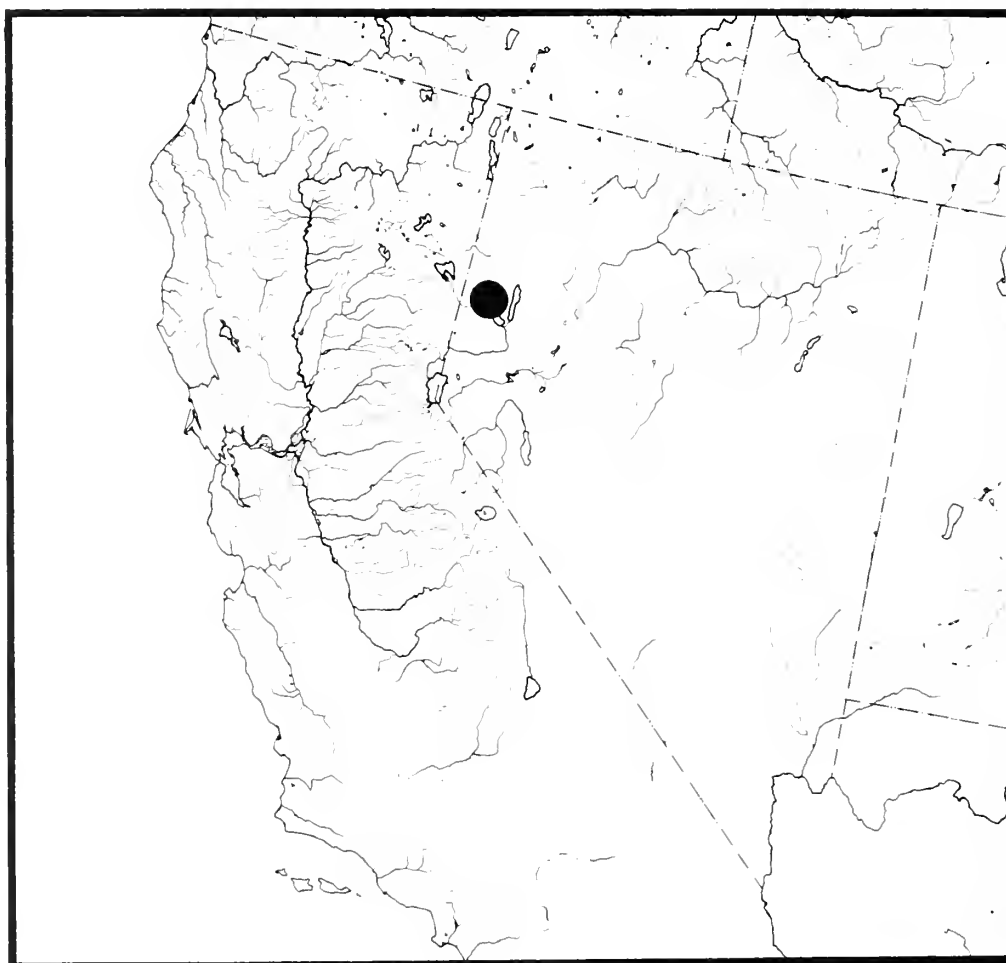
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Pyramid Lake, NV (Cope 1883. Proc. Acad. Nat. Sci. Phila. 35:134-66).

SYSTEMATICS: One of three species in genus, all with very limited distributions. *Chasmistes cujus* is very similar to *C. liorus* from Utah Lake, Bonneville basin. No systematic variational study of genus made but appears to have closest affinities with genera *Catostomus* and *Xyrauchen* (Nelson 1948. J. Morphol. 83:225-51; Miller 1958. in Zoogeography. Am. Assoc. Adv. Sci. Publ. 51:187-222).



NV: Pyramid Lake (LaRivers 1962).



DISTRIBUTION AND HABITAT: Endemic to Pyramid Lake, NV, whose level has dropped ca. 30.5 m. since 1900, and formerly Winnemucca Lake. Ascends tributary Truckee River to Derby only during spring spawning season.

BIOLOGY: Spawning runs up Truckee River occur in April and May, with spawning apparently mostly at night. When runs disturbed by low water levels, spawning may occur at river mouth. Essentially a zooplankton feeder, with most feeding probably done around rocks heavily coated with algae and populated with numerous microcrustacea (La Rivers 1962. *Fishes and Fisheries of Nevada*).

ADULT SIZE: 670 mm maximum.

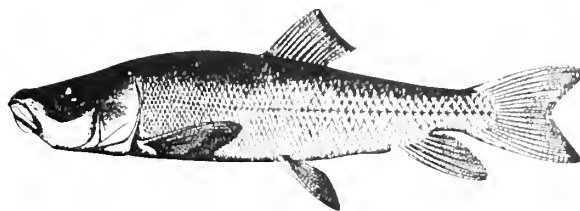
Compiler: F. C. Rohde. February 1978.

***Chasmistes liorus* Jordan**
June sucker

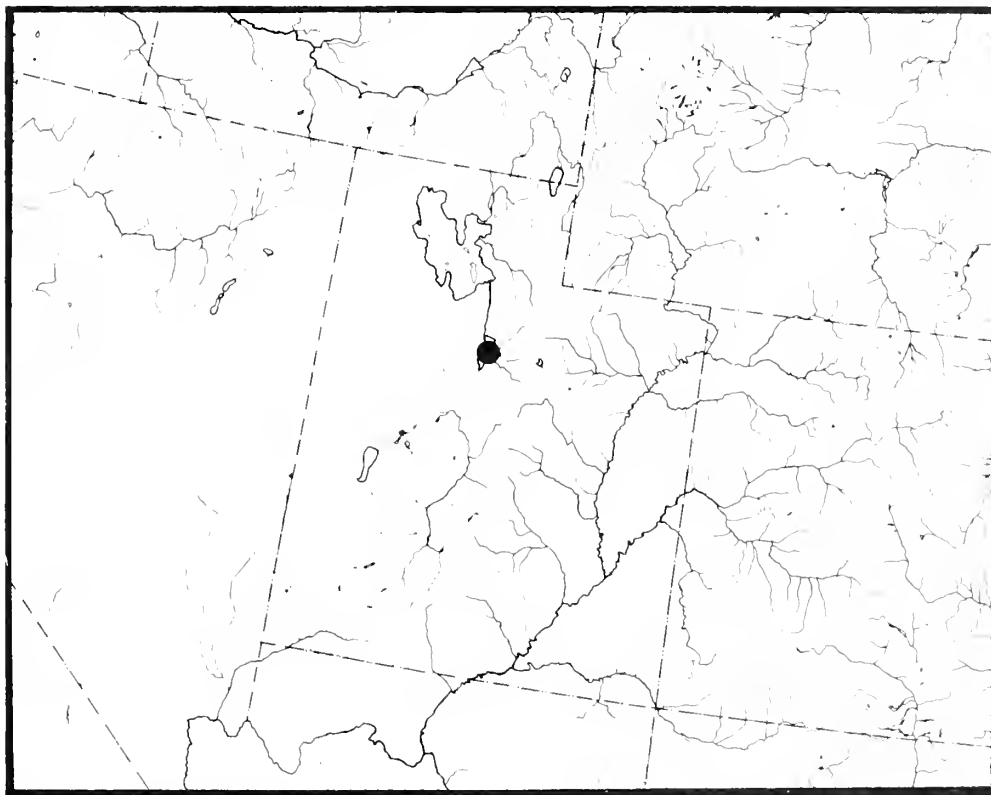
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Utah Lake at Provo, UT (Jordan 1878. Bull. U.S. Natl. Mus. 12:97-237).

SYSTEMATICS: Miller (1958. in Zoogeography Am. Assoc. Adv. Sci. Publ. 51: 187-222) indicated that *Chasmistes* belongs to subfamily Catostominae, and is most closely related to *Catostomus* and *Xyrauchen*. Thorough taxonomic study needed to clarify present confusion (Holden et al. 1974. Proc. Utah Acad. Sci. Arts. Letts. 51:46-65) concerning this species and its relationship to other species of *Chasmistes*. Morphological data given in descriptions of fossils by Miller and Smith (1967. Occas. Pap. Mus. Zool. Univ. Mich. 654:1-24), Smith (1975. Univ. Mich. Mus. Paleo. Pap. on Paleo. 14:1-68) and Kimmel (1975. Univ. Mich. Mus. Paleo. Pap. on Paleo. 14:69-87).



UT: Utah Lake (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Known only from Utah Lake, UT, but one specimen, collected from Snake River below Jackson Lake Dam, WY, may be this species (Baxter and Simon 1970. *Wyoming Fishes*). R. R. Miller, however, believes the specimen may represent a new species. Formerly inhabited deeper waters of Utah Lake, and in June migrated in large numbers up large tributary streams to spawn. Not seen for many years, and probably exterminated as result of drought conditions (with resultant higher salinities) that affected Utah Lake in mid-1930's.

ADULT SIZE: Probably attained similar size to *C. cujus*, which reaches total length of about 600 mm.

BIOLOGY: Nothing specifically known for this species, but aspects of life history probably similar to those described by La Rivers (1962. *Fishes and Fisheries of Nevada*) for closely related *Chasmistes cujus*.

Compilers: F. C. Rohde and C. R. Gilbert.
August 1978.

***Cycleptus elongatus* (Lesueur)**
Blue sucker

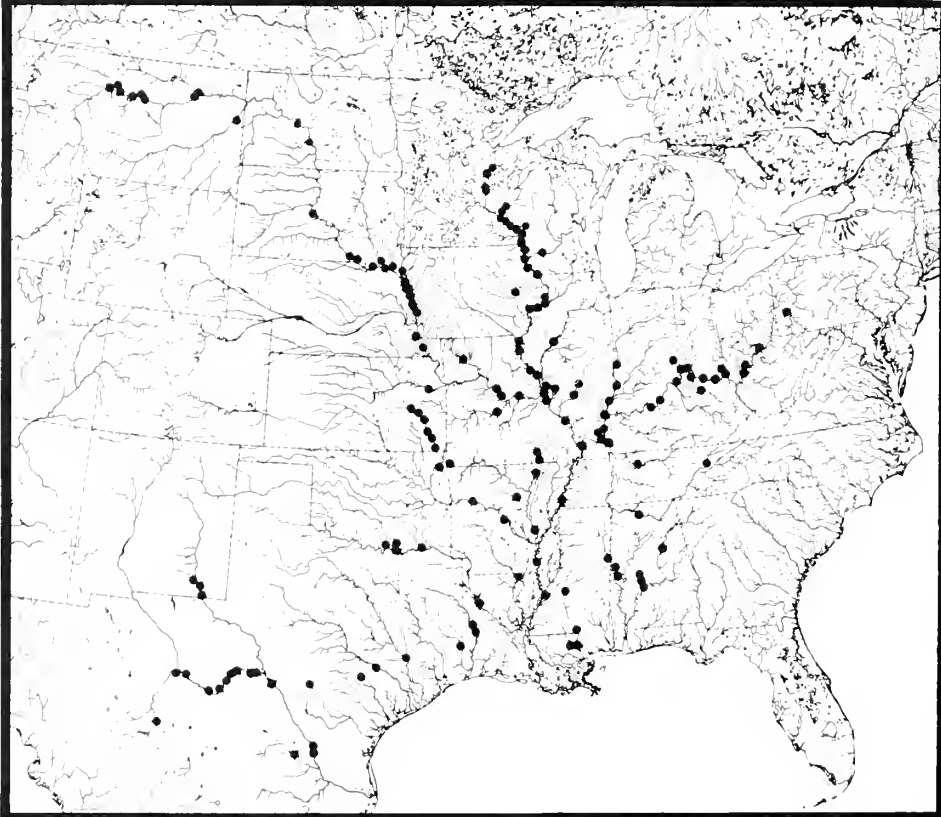
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Ohio River (Lesueur 1817. J. Acad. Nat. Sci. Phila. 1:88-96, 102-111).

SYSTEMATICS: Monotypic genus, comprising its own subfamily Cycleptinae (Nelson 1976. *Fishes of the World*). Probably most closely related to the primitive Asiatic genus *Myxocyprinus* (Nelson 1948. J. Morphol. 83:225-51; Miller 1958. in Zoogeography. Am. Assoc. Adv. Sci. Publ. 51:187-222). No systematic variational study of the species has been done.



AL: Sumter-Greene Co., Tombigbee River system, 245 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Limited to the largest rivers and lower parts of their major tributaries, from the Rio Grande, in Mexico, TX and NM, east on the Gulf coast to the Mobile Bay basin of AL; and north in the Mississippi River basin to the Missouri River drainage of eastern MT and the Ohio River drainage of western PA. Usually inhabits channels and flowing pools with a moderate current, but seems to do well in at least some artificial impoundments. Cross (1967. *Handbook of Fishes of Kansas*) suggested that dams may contribute to decline of the species by blocking spawning migrations and inundating spawning areas. Bottom type usually consists of exposed bed-rock, perhaps in combination with hard clay, sand and gravel. Trautman (1957. *The Fishes of Ohio*) indicated that the species is intolerant of highly turbid conditions, but its natural presence throughout much of the Missouri

River suggests that this is not entirely true. Sometimes common in preferred habitat, but overall much reduced in abundance.

ADULT SIZE: 400-930 mm TL.

BIOLOGY: Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) summarized information of age and growth, based on studies in reservoirs in SD and OK. May reach ten years of age. Brown (1971. *Fishes of Montana*) states that this species feeds mainly on aquatic insects and other small invertebrates, but may also utilize plant material. Individuals in breeding condition have been taken in KS in April at water temperatures of 10-15°C. Adults probably winter in deep pools and move upstream in spring to spawn on riffles.

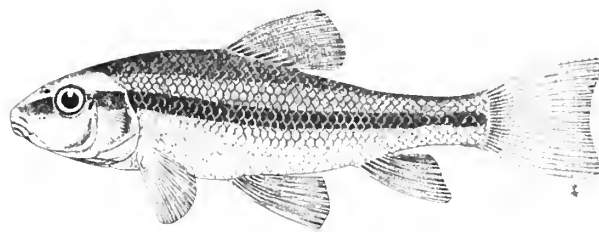
Compiler: C. R. Gilbert. September 1978.

Erimyzon oblongus (Mitchill)
Creek chubsucker

Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: New York (Mitchill 1814. Rept. on Fishes of New York:1-30).

SYSTEMATICS: Hubbs (Misc. Publ. Mus. Zool. Univ. Mich. 20:1-47) recognized specific validity of *E. oblongus*, and three subspecies: *E. o. oblongus*, *E. o. clariformis*, and *E. o. connectens*. Bailey et al. (1954. Proc. Acad. Nat. Sci. Phila. 106:109-64) questioned validity of *E. o. connectens* and most subsequent authors have concurred. Variation in genus *Erimyzon* being studied by B. R. Wall, Jr.



MD: Charles Co., Wheatley Run (NCSM).

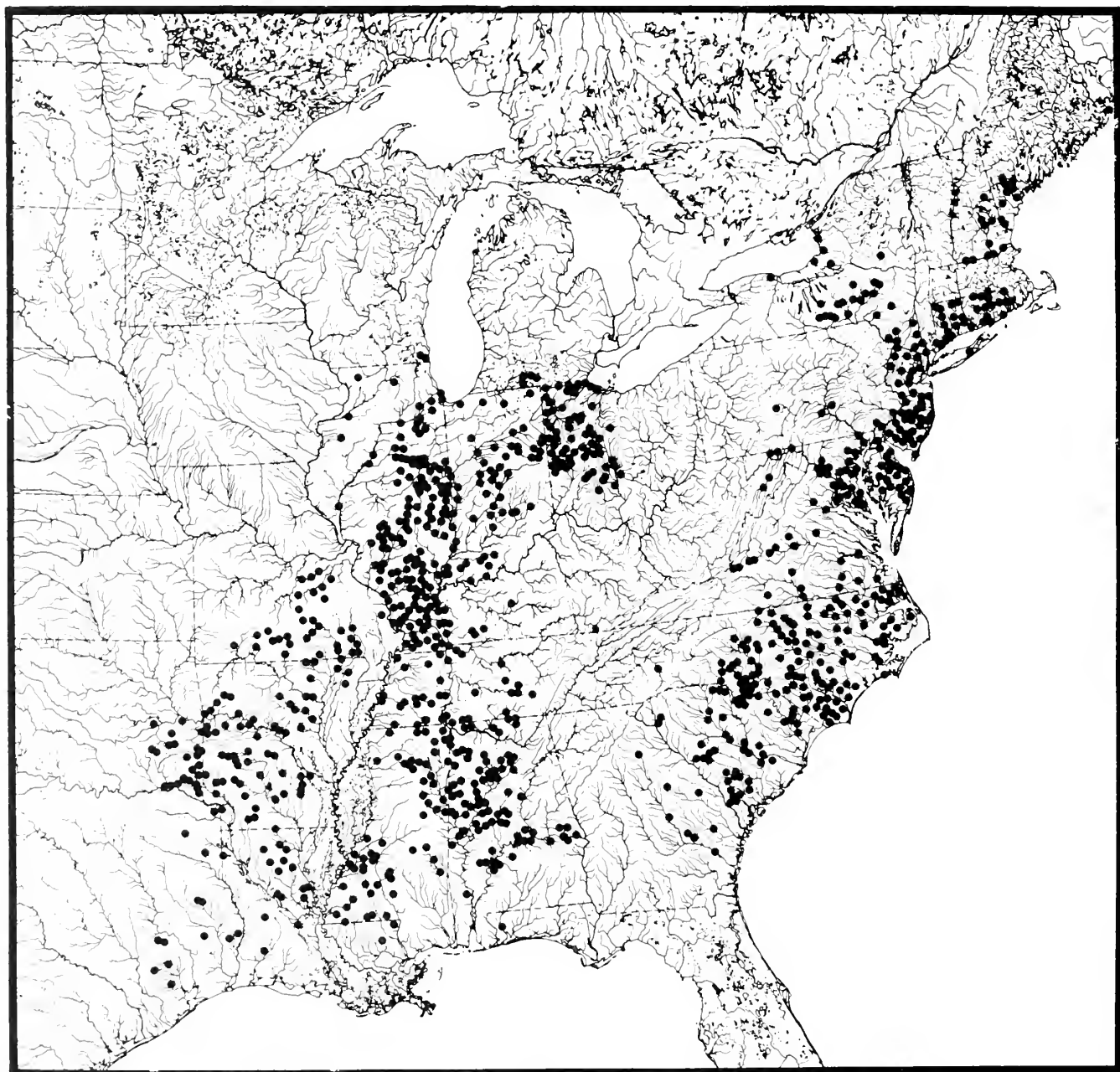
See map on next page

DISTRIBUTION AND HABITAT: Atlantic slope streams from ME to Altamaha drainage of GA; Gulf slope streams east to Escambia River drainage, FL, and Chattahoochee River drainage, AL (single population) and west to San Jacinto system, TX. Mississippi Valley in LA, AR, southeast OK, upland MO, MS, west TN, west KY, south and east IL, IN, and west-central OH. In Great Lakes drainage in southern tributaries to lakes Michigan, Erie, and Ontario. Formerly in or incorrectly reported from NS, NK, and St. Lawrence River basin, Canada. Represented on Atlantic slope by *E. o. oblongus*, on Gulf slope by *E. o. clariformis*. Intergrades (nominal *E. o. connectens*) found in Altamaha River system and adjacent drainages to north. Occupies small rivers and creeks with wide variety of gradients, bottom types, and vegetation, depending somewhat on age and stage of reproductive cycle. Seldom, if ever, occupies impoundments or springs, but may be taken in spring-fed creeks. Young typically in headwater rivulets. Adults usually not taken in large series. Populations apparently declining in streams subject to siltation.

BIOLOGY: Abbott (1884. *in* Breder and Rosen 1966. *Modes of Reproduction in Fishes*) reported on sound production. Hankinson (1920. Trans. Ill. State Acad. Sci. 12:132-50) observed stone pulling by males and apparent acts of spawning. Branson (1961. Trans. Kans. Acad. Sci. 64:360-73) described tubercle pattern of AR population and commented on phylogenetic significance. Larimore and Smith (1963. Bull. Ill. Nat. Hist. Sur. 28:1-28) noted species associates and apparent responses to stream modification. Smith (1963. Copeia:251-59) studied seasonal distribution in modified stream. Wagner and Cooper (1963. Copeia:350-57) studied population density, growth, and fecundity. Breder (*in* Breder and Rosen 1966) reported post-spawning mortality in NJ. Mansueti and Hardy (1967. *Development of Fishes of Chesapeake Bay Region*, Vol. 1) described early development. Eastman (1977. Am. Midl. Nat. 97:68-88) studied anatomy of pharyngeal bone and teeth in relation to diet. Gatz (1979. Tulane Stud. Zool. Bot. 21:91-124) studied ecological morphology. Evans and Noble (1979. Am. Midl. Nat. 101:333-43) discussed population size composition in relation to longitudinal position in stream. Overall summaries by Trautman (1957. *The Fishes of Ohio*), Pflieger (1975. *The Fishes of Missouri*), and Smith (1979. *The Fishes of Illinois*).

ADULT SIZE: 132 - 288 mm SL.

Compilers: B. R. Wall, Jr. and C. R. Gilbert.
January 1980.



Distribution of the creek chubsucker, *Erimyzon oblongus*

Erimyzon sucetta (Lacepede)
Lake chubsucker

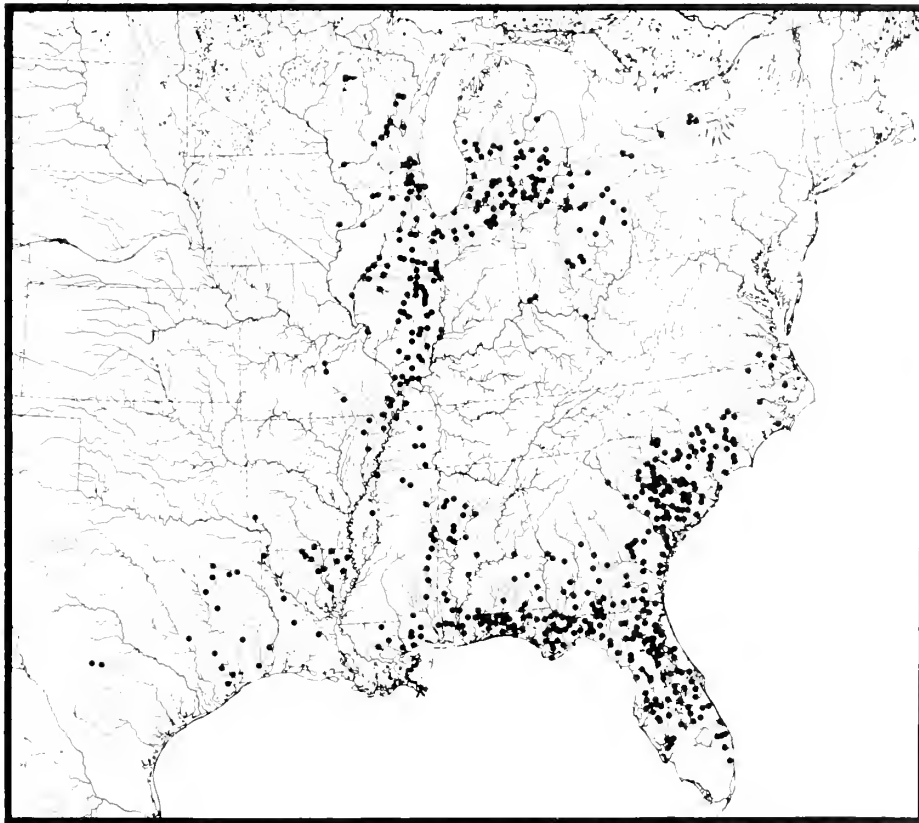
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: South Carolina (Lacepede 1803. *Histoire Naturelle des Poissons* 5:1-803).

SYSTEMATICS: Hubbs (1930. Misc. Publ. Mus. Zool. Univ. Mich. 20:1-47) recognized subspecies *E. s. sucetta* and *E. s. kennerlyi* (sic), but Bailey et al. (1954. Proc. Acad. Nat. Sci. Phila. 106:109-64) and most subsequent authors have regarded differentiation invalid. Variation in genus currently being studied by B. R. Wall, Jr.



SC: Barnwell Co., Savannah
River system, 173 mm SL
(Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Atlantic slope north to VA and south to tributaries of Lake Okeechobee, FL; Gulf slope south to Charlotte Harbor drainage, FL, and west to Guadalupe River system, TX. Mississippi Valley in LA, AR, southeast MO, MS, west TN, west KY, IL, IN, and OH. In southern tributaries of Great Lakes drainage to lakes Michigan, Huron, Erie, and Ontario. Found on Canadian side of lakes Erie and St. Clair. Common on lower Coastal Plain; less abundant in inland portions of range. Occupies ponds, oxbows, sloughs, impoundments, and similar waters of little or no flow that are clear and have bottoms of sand or silt mixed with organic debris. Aquatic vegetation usually present. Abundance apparently declining in areas subject to siltation.

ADULT SIZE: 130-386 SL mm.

BIOLOGY: Odum and Caldwell (1955. Copeia:104-06) investigated respiration in anaerobic FL spring. Hildebrand (1967. Trans. Am. Fish. Soc. 96:414-16) studied effects of herbicides on fertilized eggs and fry. Reproductive biology summarized by Scott and Crossman (1973. *Freshwater Fishes of Canada*). Overall summaries by Trautman (1957. *The Fishes of Ohio*), Pflieger (1975. *The Fishes of Missouri*), and Smith (1979. *The Fishes of Illinois*).

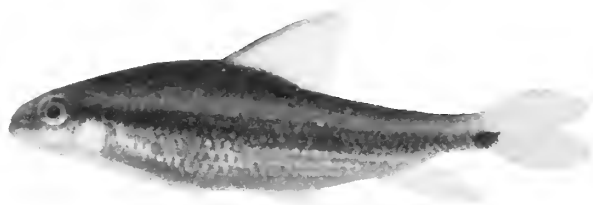
Compilers: B. R. Wall, Jr. and C. R. Gilbert.
January 1980.

Erimyzon tenuis (Agassiz)
Sharpfin chubsucker

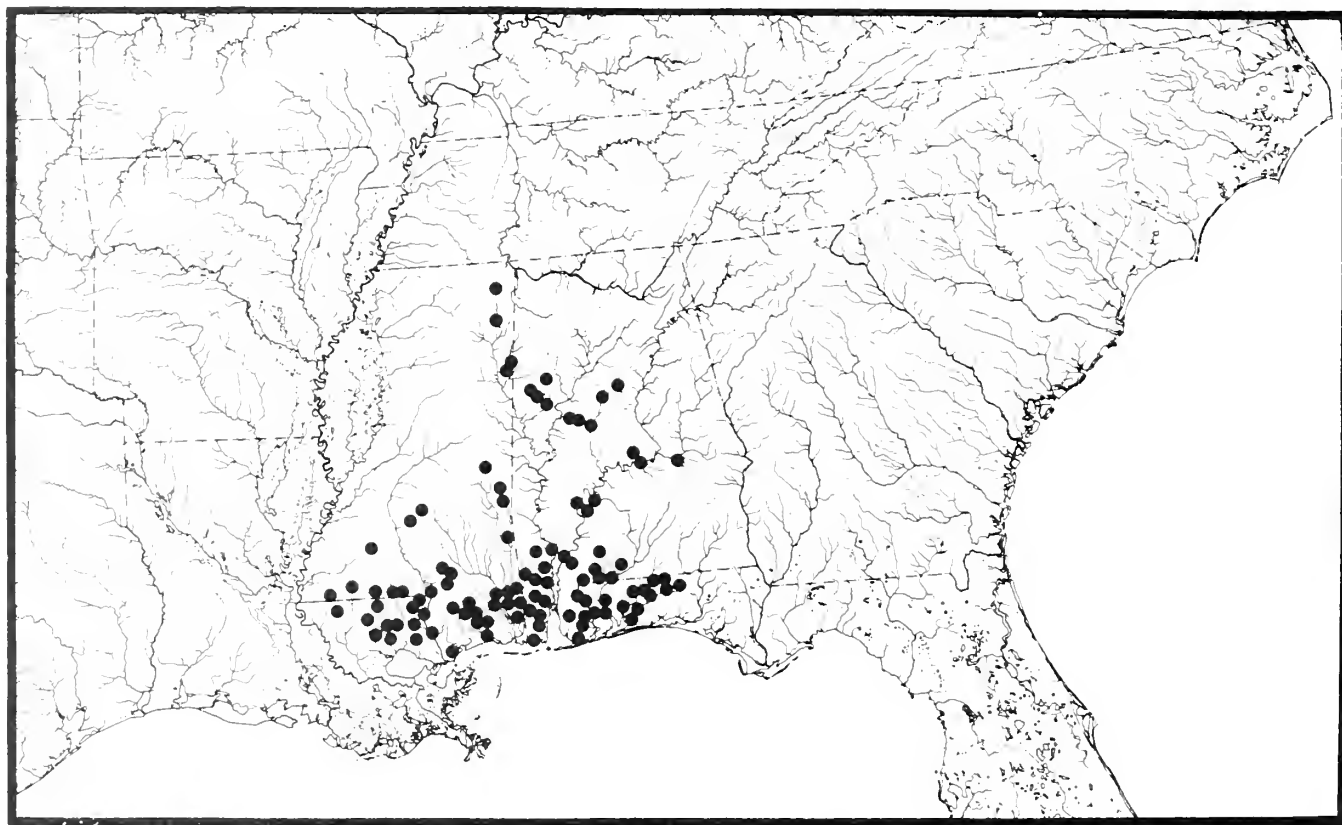
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Mobile, AL (Agassiz 1855. Am. J. Sci. Arts: 71-99, 215-31).

SYSTEMATICS: Regarded as synonym of *E. sucetta* by Jordan and Evermann (1896. U.S. Natl. Mus. Bull. 47:1-1240). Recognized as valid species by Hubbs (1930. Misc. Publ. Mus. Zool. Univ. Mich. 20:1-47). Variation in genus being studied by B. R. Wall, Jr.



FL: Santa Rosa Co., Pine Creek, 83 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Streams of Gulf slope. Common in small streams of lower Coastal Plain as far west as Amite River system of LA and MS and as far east as Yellow River system of AL and FL. Choctawhatchee River drainage records (Bailey et al. 1954. Proc. Acad. Nat. Sci. Phila. 106:109-64) based on young *E. sucetta* (M.F. Mettee, pers. comm.). Less common in streams of Upper Coastal Plain, very rare above Fall Line. Occupies tannin-stained to clear streams, pools, and backwaters with rooted aquatic vegetation and bottoms of sand or silt mixed with organic matter.

ADULT SIZE: 129-300 mm SL.

BIOLOGY: Gunning (1964. Prog. Fish Cult. 2:76-79) studied population stability in headwater stream. Gunning and Berra (1968. Prog. Fish Cult. 2:92-95; 1969. Trans. Am. Fish. Soc.:305-08) studied repopulation in experimentally decimated stream segments.

Compilers: B. R. Wall, Jr. and C. R. Gilbert.
January 1980.

***Hypentelium etowanum* (Jordan)**
Alabama hog sucker

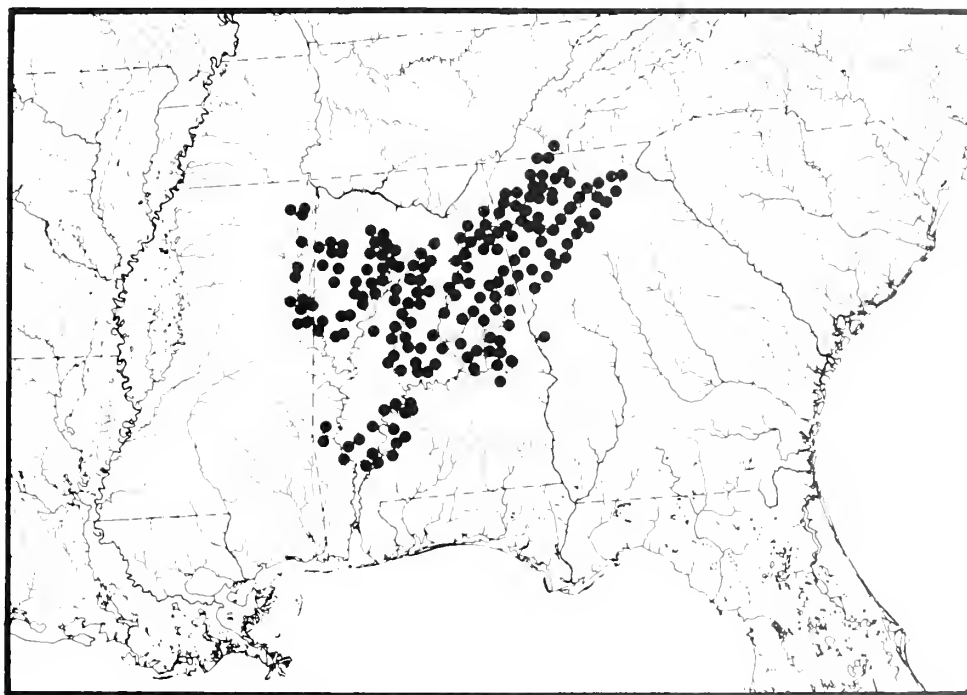
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Etowah and Oostan-
aula rivers, Rome, GA (Jordan 1877. Ann.
N. Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Elevated to full species by
Hubbs (1930. Misc. Publ. Mus. Zool. Univ.
Mich. 20:1-47). Closest relative is *H. nigri-
cans* (Raney and Lachner 1947. Am. Mus.
Novit. 1333:1-15; Jenkins 1970. Ph.D. diss.,
Cornell Univ.; Buth 1978. Ph.D. diss., Univ.
Illinois).



AL: Cherokee Co., Coosa River
system, 91.5 mm SL (Smith-
Vaniz 1968).



DISTRIBUTION AND HABITAT: Widely
distributed and often locally abundant
throughout upper Mobile Bay drainage and
Chattahoochee system of Apalachicola drain-
age. Recently discovered in Tennessee Ri-
ver drainage in Baker Creek, Polk Co., TN
(UT 45.126). Prefers clear, high-gradient
streams where it occupies rapids and runs
with rock or gravel substrates.

ADULT SIZE: To approximately 230 mm TL.

BIOLOGY: Little known, but presumably
similar to *H. nigricans*. Swingle (1965. Au-
burn Univ. Agric. Exp. Sta. Zool. Ent. Ser.
Fish. 3) summarized length-weight relation-
ship. Parasites discussed by Rogers (1968.
J. Parasitol. 54:490-95), Chien and Rogers
(1970. J. Parasitol. 56:480-85), Johnson
(1971. J. Ala. Acad. Sci. 42:243-47), Mack-
iewicz (1972. J. Parasitol. 58:1075-81), and
Williams (1974. Trans. Am. Fish. Soc. 103:
610-15).

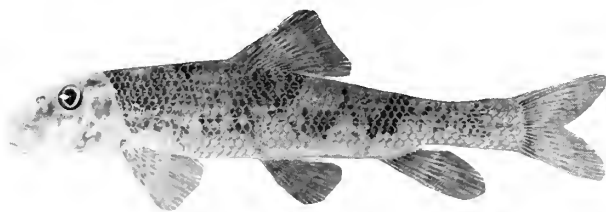
Compilers: D. G. Buth and R. W. Murphy.
January 1979.

Hypentelium nigricans (Lesueur)
Northern hog sucker

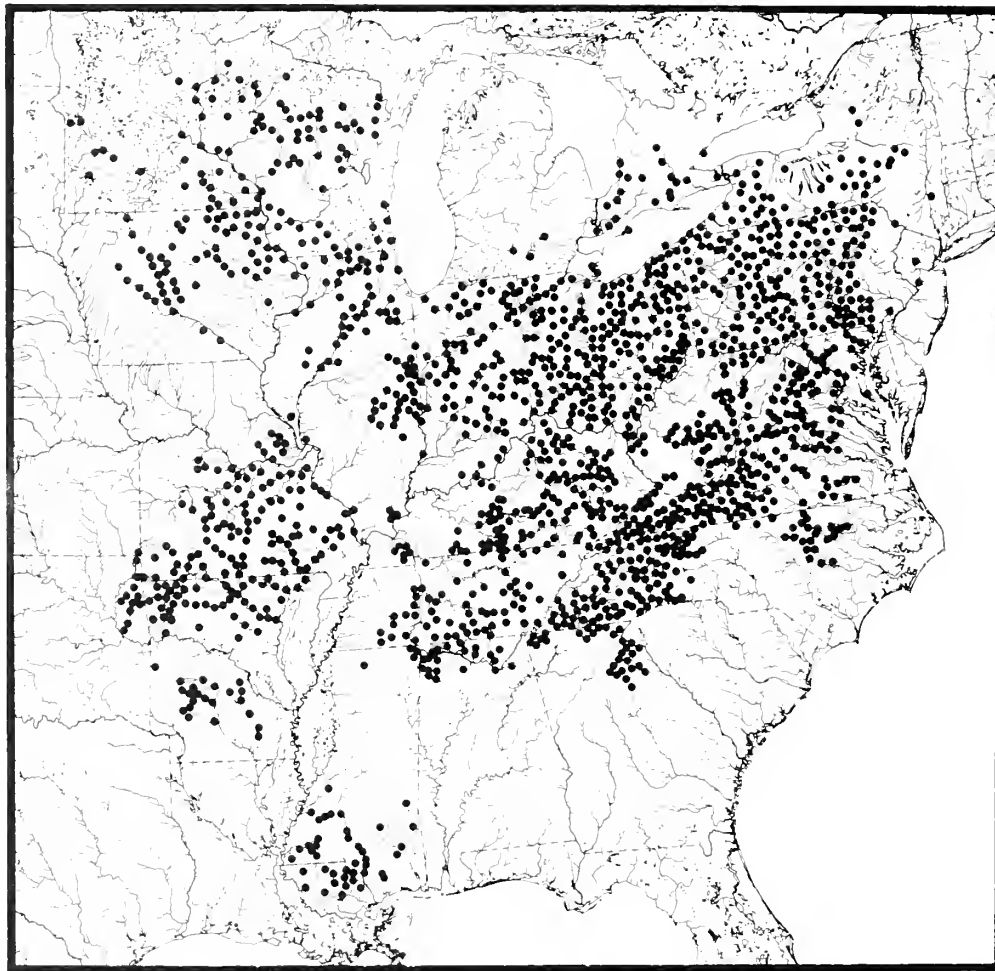
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Lake Erie (Lesueur 1817. J. Acad. Nat. Sci. Phila. 1:102-11).

SYSTEMATICS: Closest relative is *H. etowanum* (Raney and Lachner 1947. Am. Mus. Novit. 1333:1-15, Jenkins 1970 Ph.D. diss., Cornell Univ.; Buth 1978. Ph.D. diss., Univ. Illinois). Clinal genetic variability seen in alcohol dehydrogenase (Buth 1977. Biochem. Syst. Ecol. 5:61-63). No subspecies recognized.



MD: Baltimore Co., Gwynn's Falls, Potomac drainage, 104 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Widespread and often abundant throughout Mississippi and Ohio basins, through ON in Great Lakes basin and in upper reaches of most Atlantic slope streams south to northern GA. Recently reported from upper Mobile Bay drainage (Stiles and Etnier 1971. J. Tenn. Acad. Sci. 46:12-16) and Chattahoochee sys. of Apalachicola drainage (Auburn Univ. AU 3368). Prefers riffles and adjacent pools of clear shallow streams with gravel to rubble substrates.

ADULT SIZE: 135-460 mm TL, 610 mm TL maximum.

BIOLOGY: Growth and general biology discussed by Raney and Lachner (1946. Am. Midl. Nat. 36:76-86). Fish (1935. Bull. U.S. Bur. Fish. [1931-33] 47:293-398) and Burnak and Mohr (1978. Trans. Am. Fish. Soc. 107: 595-99) described early development. Overall summaries provided by Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), Scott and Crossman (1973. *Freshwater Fishes of Canada*), and Pflieger (1975. *The Fishes of Missouri*).

Compilers: D. G. Buth and R. W. Murphy. January 1979.

Hypentelium roanokense Raney and Lachner
Roanoke hog sucker

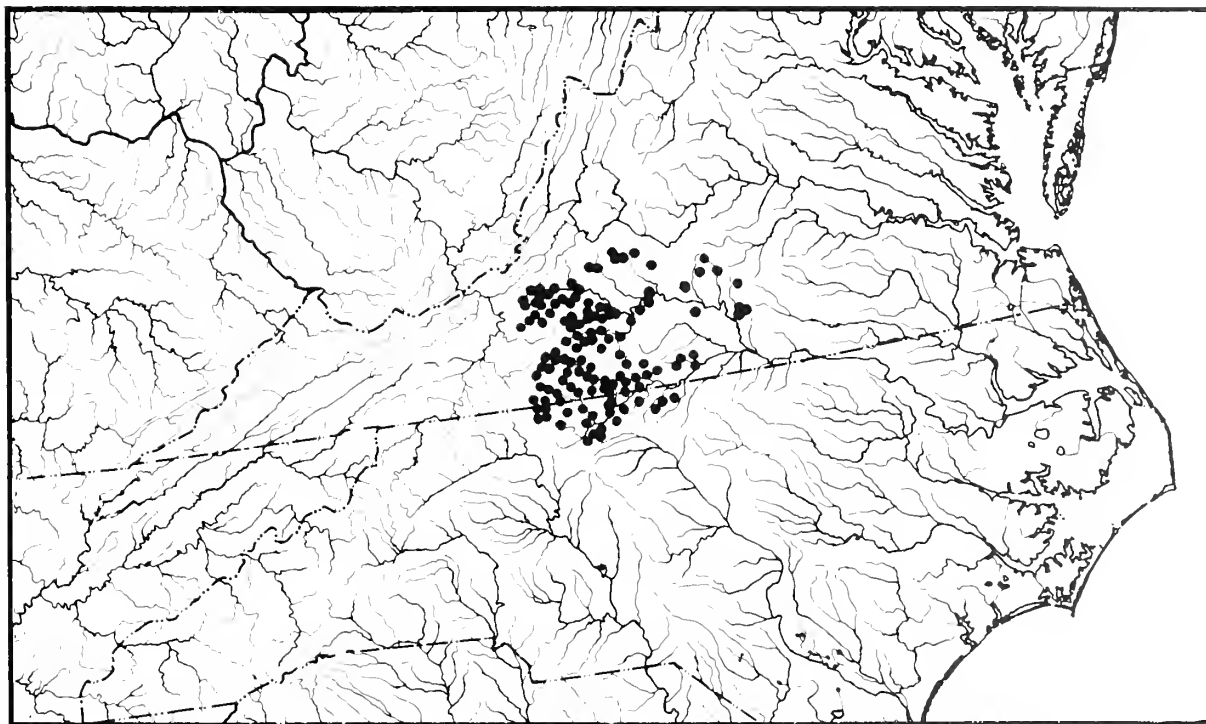
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Horse Pasture Creek, at U.S. hwy. 58 bridge, 2.4 km ne of Spencer, Henry Co., VA (Raney and Lachner 1947. Am. Mus. Novit. 1333:1-15).

SYSTEMATICS: Genus most closely related to small torrent suckers of Appalachian group *Thoburnia*, a subgenus of *Moxostoma*. Of the three species of *Hypentelium*, *H. roanokense* is phenotypically most distinctive. No significant intraspecific variation detected (Jenkins 1970. Ph.D. diss., Cornell Univ.; Buth 1978. Ph.D. diss., Univ. Illinois). Geographic range almost completely overlaps that of *H. nigricans* in Roanoke drainage (except for Chowan System), and both species commonly occur syntopically. No hybrids identified.



NC: Stokes Co., Dan River,
81 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to Roanoke River drainage, VA and NC, where extends widely from Ridge and Valley province into central Piedmont province. Occupies both main branches of upper Roanoke (Roanoke proper and Dan River systems). Unknown from Banister River watershed (largest lower Dan River tributary, entirely on Piedmont) and Chowan River system (on outer Piedmont and Coastal Plain); the former has been only sparsely collected, the latter well surveyed. Generally distributed, although usually taken in small numbers, in mountains and inner Piedmont uplands; localized and/or rare in central Piedmont. Inhabits small to medium-sized, cool to warm streams where typically occupies riffles and runs of gravel, rubble, and boulder substrates. Occasionally found in slower current

over partly sand substrate. Although seemingly better adapted morphologically for swift currents than syntopic *H. nigricans* (Raney and Lachner 1947), considerable collecting has shown no obvious habitat segregation.

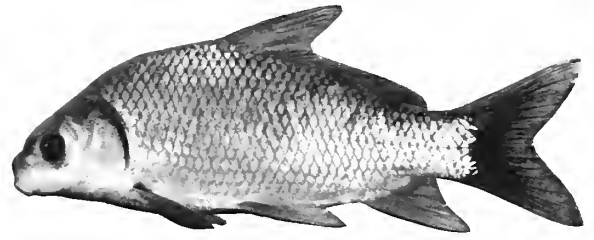
ADULT SIZE: 60-140 mm SL.

BIOLOGY: Diet unknown. Most males mature in two years, some in one; females mature in three years. Some females live five years, outliving most males by one or two years. Dwarf sucker; females attain larger size than males (Raney and Lachner 1947). Spawns in mid- and/or late spring, based on gonadal and tubercle development.

Compiler: R. E. Jenkins. February 1979.

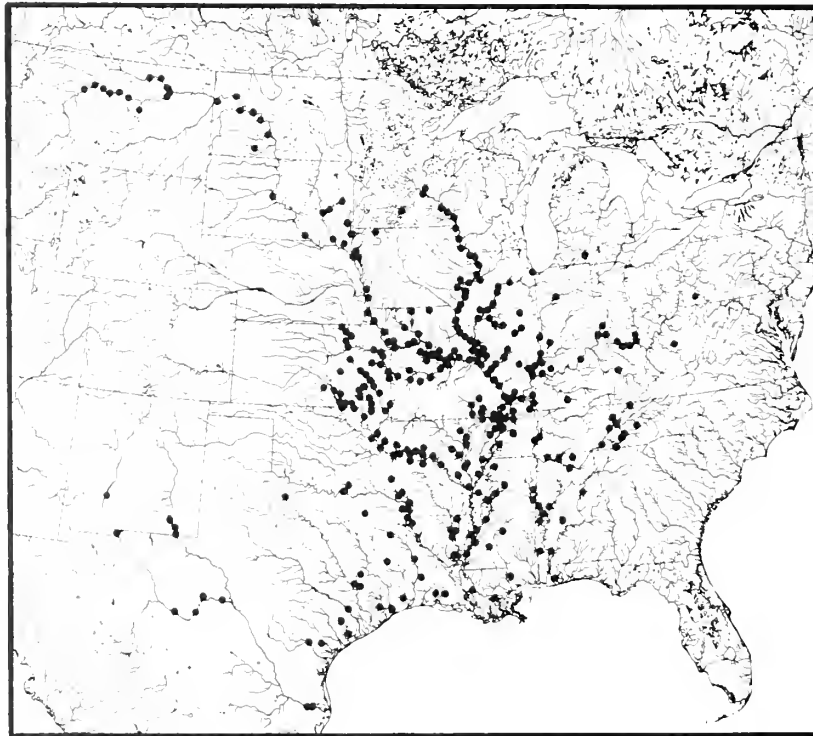
Ictiobus bubalus (Rafinesque)
Smallmouth buffalo

Order Cypriniformes
Family Catostomidae



MO: New Madrid Co.,
Mississippi River at New
Madrid (Mo. Dept. Cons.).

TYPE LOCALITY: Ohio River (Rafinesque 1818. Am. Month. Mag. Crit. Rev. 3:354-56).
SYSTEMATICS: Subfamily Ictiobinae. Genus most closely related to *Carpionodes*, based on studies of Weberian apparatus and opercular series (Nelson 1948. J. Morphol. 83:225-45; 1949. J. Morphol. 85:559-67). Miller (1959. in Zoogeography. Am. Assoc. Adv. Sci. Publ. 9:187-222) diagrammed generic relationships. Systematics of genus not thoroughly studied since status of buffalo suckers clarified by Hubbs (1930. Misc. Publ. Mus. Zool. Univ. Mich. 20:1-47). Natural hybridization with *I. cyprinellus* reported. *Ictiobus niger* has been artificially crossed with *I. bubalus* (Stevenson 1964. U.S. Fish Wildl. Serv. Circ. 178:29-100).



DISTRIBUTION AND HABITAT: Confined primarily to larger tributaries of Mississippi basin from MT east to WV and PA, and in Gulf slope drainages from Mobile Bay west to Rio Grande basin, TX and Mexico. Often common in waters with modest current. Established transplanted populations in central AZ not shown. Often common in clear waters with modest current.

ADULT SIZE: 390-780 mm TL.

BIOLOGY: Jester (1973. N.M. Agric. Exp. Stn. Res. Rep. 261:1-111) studied life history, ecology, and management in Elephant Butte Lake, NM. Spawns from March to September at 15.5 - 27.5°C, with peak

activity in July. Spawns on shoals of lakes at depths of 1.2 - 6.1 m. Fecundity ranges from 18,200 - 525,000 ova, depending on size of fish. Principal foods include ostracods and dipteran larvae. Primarily near-shore bottom feeder (McComish 1967. Trans. Am. Fish. Soc. 96:70-74) unlike *I. cyprinellus* which is plankton feeder. Information on age and growth provided by Schoffman (1944. J. Tenn. Acad. Sci. 19:3-9) and Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), and on breeding by Katz (1954. *Reproduction of Fish. Data for Handbook of Biological Data*).

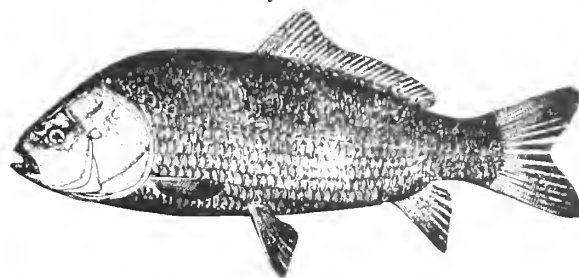
Compiler: D. S. Lee. July 1979.

Ictiobus cyprinellus (Valenciennes)
Bigmouth buffalo

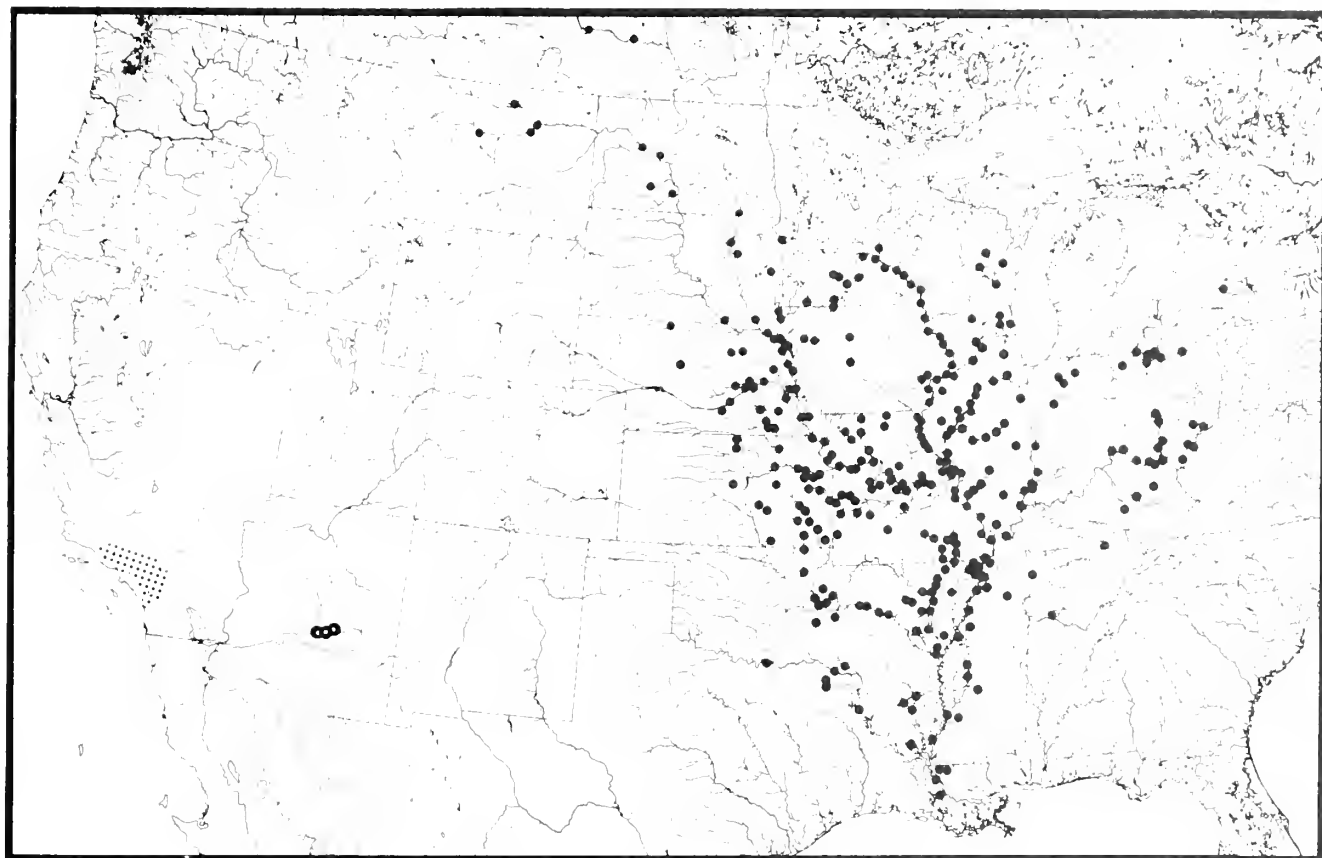
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Lake Ponchartrain, LA (Valenciennes *in* Cuvier and Valenciennes 1844. *Histoire Naturelle des Poissons* 17:1-497).

SYSTEMATICS: Apparently not studied in detail. Natural hybridization with closely related *I. bubalus* occurs (Johnson and Minckley 1969. *Copeia*:198-200) and hybrids between *I. cyprinellus* and *I. niger* have been cultured (Stevenson 1964. *U.S. Fish Wildl. Serv. Circ.* [1963] 178:79-100).



IL: at Normal (Jordan and Evermann 1900).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Lake Erie drainage south in Ohio and Mississippi drainages to northern AL, southern LA, TX, OK, and AR, west and north to MN, MB, and SA. Introduced in AZ and CA. Common in shallows of large sluggish rivers, oxbows, bayous, reservoirs, and lakes.

ADULT SIZE: 254-457 mm TL, 889 mm TL maximum.

BIOLOGY: Johnson (1963. *J. Fish. Res. Board Can.* 20:1397-1429) studied reproduction, age, growth, food habits, and parasites of SA population. Spring flooding necessary to trigger spawning, which occurs in shallow waters at temperatures of 15.5°-18.3°C. Some individuals estimated to be 20 years old. Occupies feeding niche overlapping bottom and limnetic plankton feeders Minckley et al. 1970. *Trans. Am. Fish. Soc.* 99:333-42).

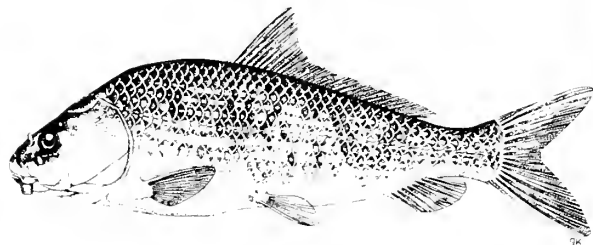
Compilers: D.S. Lee and J.R. Shute. June 1978.

***Ictiobus niger* (Rafinesque)**
Black buffalo

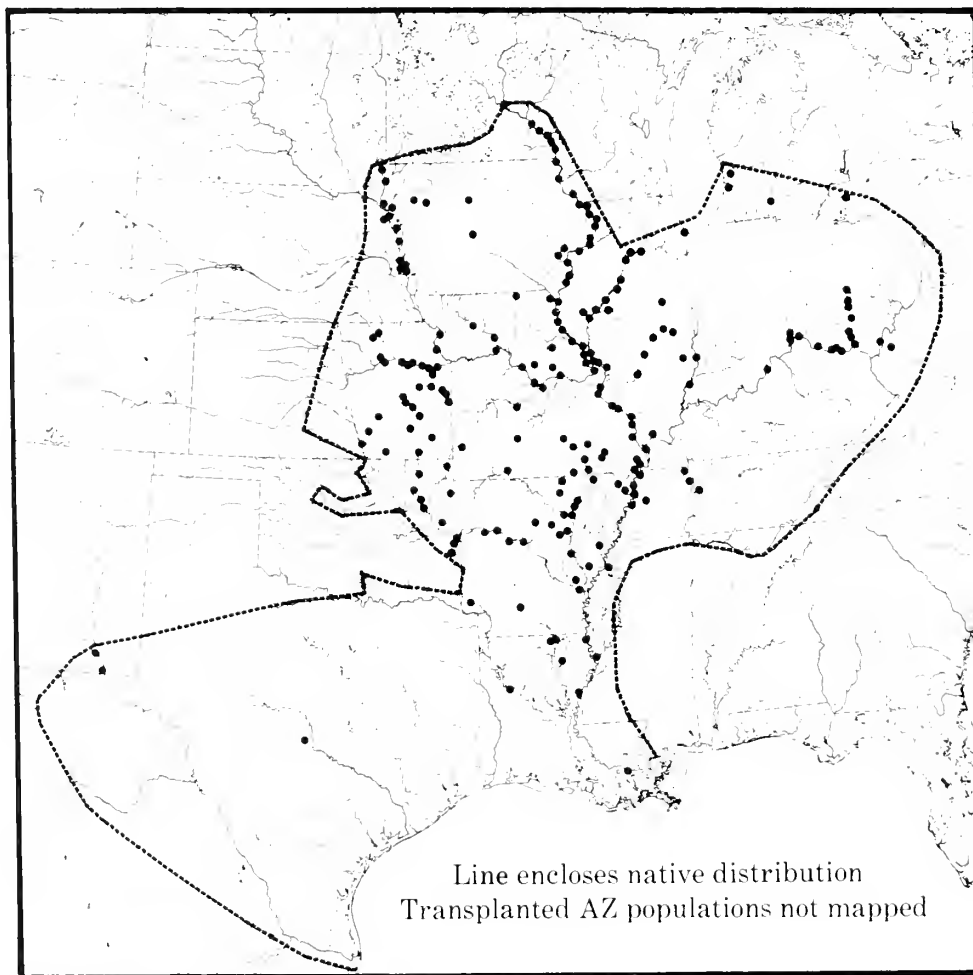
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Ohio River (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Early taxonomic and nomenclatural problem clarified by Hubbs (1930. Misc. Publ. Mus. Zool. Univ. Mich. 20:1-47). Artificially crossed with *I. bubalus* and *I. cyprinellus*. Artificial hybrids have been produced between *I. niger* and *I. cyprinellus* (Stevenson 1964. U.S. Fish Wildl. Serv. Circ. 178:79-100), and natural hybrids are also known (Miller and Robison 1973. *The Fishes of Oklahoma*).



KY: Hardin Co., Ohio River
(NCSM).



DISTRIBUTION AND HABITAT: In many large and some smaller rivers of the Mississippi, Missouri, and Ohio river basins, from NB east to WV, south to the Gulf coast (Mississippi and Red rivers). Recorded by Conner (1977. Ph.D. diss., Tulane Univ.) as rare and extirpated or depleted in Calcasieu, Sabine, Brazos, and Rio Grande drainages. Rarity and disjunct distributions of species in this area suggests possibility of introduction or misidentifications of locally common and very similar *I. bubalus*. Often found in strong currents or large rivers. Usually less abundant than the other two species.

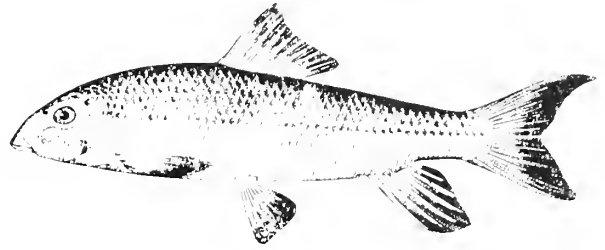
ADULT SIZE: 381-660 mm TL.

BIOLOGY: Eats plankton, insect larvae, and vegetation. Snails and other small mollusks also eaten, often in large quantities (Harlan and Speaker 1969. *Iowa Fish and Fishing*). Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) gave age-growth data.

Compiler: J. R. Shute. June 1978.

Lagochila lacera Jordan and Brayton
Harelip sucker

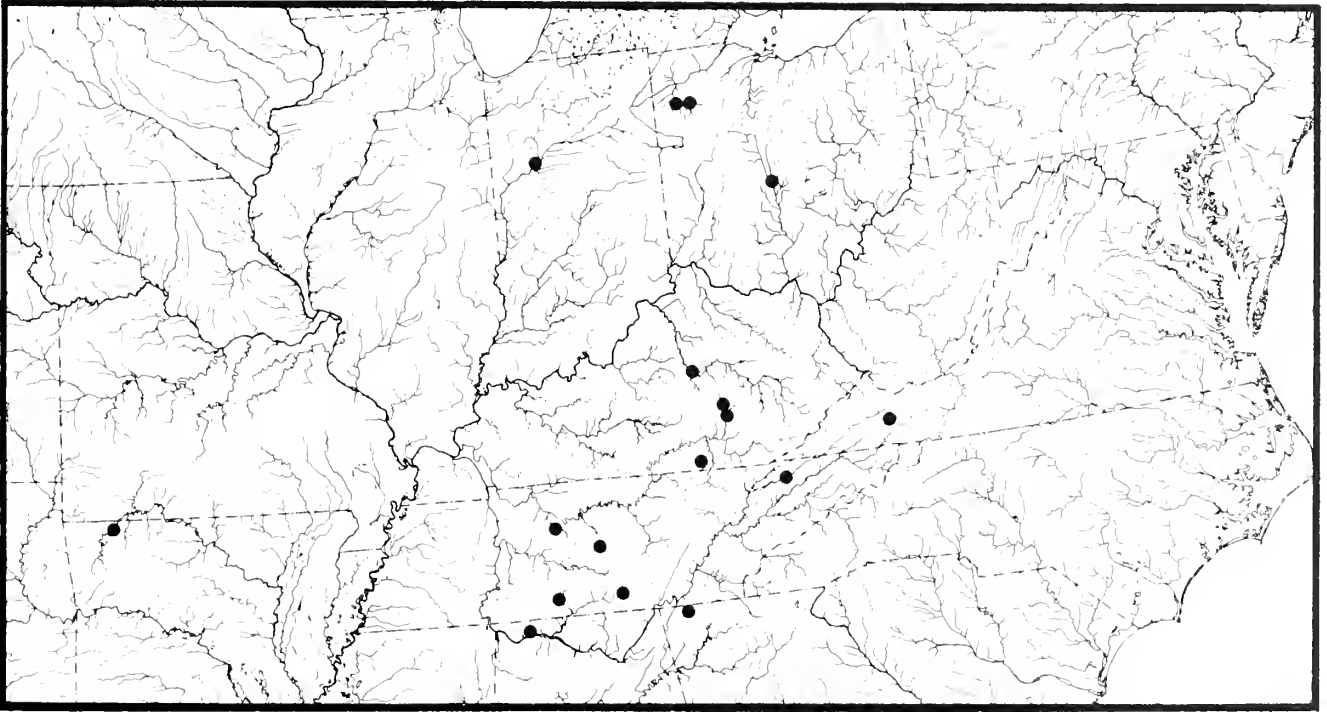
Order Cypriniformes
Family Catostomidae



TN: Fairview (Jordan and
Evermann 1900).

TYPE LOCALITY: Chickamauga River near Ringgold, Catoosa Co., GA, and Elk River at Estill Springs, Franklin Co., TN (Jordan and Brayton 1877. Proc. Acad. Nat. Sci. Phila. 29:280-83). Chickamauga specimen regarded (Jenkins 1970. Ph.D. diss., Cornell Univ.) to have been designated lectotype by Jordan and Evermann (1896. U.S. Natl. Mus. Bull. 47:1-1240).

SYSTEMATICS: Very distinctive, specialized monotypic genus, particularly on basis of trophic morphology. Detailed description by Jenkins (1970; and later study). Aspects of sensory morphology treated by Miller and Evans (1965. Copeia:467-87). Masticatory apparatus described by Eastman (1977. Am. Midl. Nat. 97:68-88). Probably diverged from redhorse sucker lineage, subgenus *Morostoma* (Jenkins 1970).



DISTRIBUTION AND HABITAT: Extinct; collected between 1859 and 1893. Once ranged widely. Known from five drainages of lower and central Ohio River basin, AL, GA, TN, VA, KY, IN, and OH; upper White River drainage of the Ozarks, AR and undoubtedly MO; and Maumee River drainage of Lake Erie basin, OH. Apparently preferred medium to large size, warm streams of moderate gradient and with relatively low turbidity and silt levels. Habitat probably pools and slower runs, based on form of body and certain fins and on size of swim bladder and cerebellum. General abundance uncertain as only 28 specimens known, but reported common to abundant in some streams.

ADULT SIZE: Only extant adult a female 313 mm SL. Apparently a moderate size sucker.

BIOLOGY: Probably mainly a sight feeder (Miller and Evans 1965). Contents of nine alimentary tracts studied dominated by snails; limpets, fingernail clams, copepods, cladocerans, water mites, and small aquatic insects also in some specimens. Apparently migrated and spawned in spring.

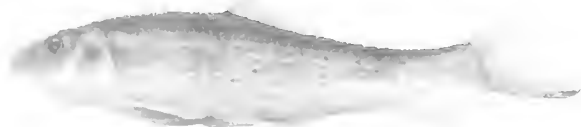
Compiler: R. E. Jenkins. January 1980.

Minytrema melanops (Rafinesque)
Spotted sucker

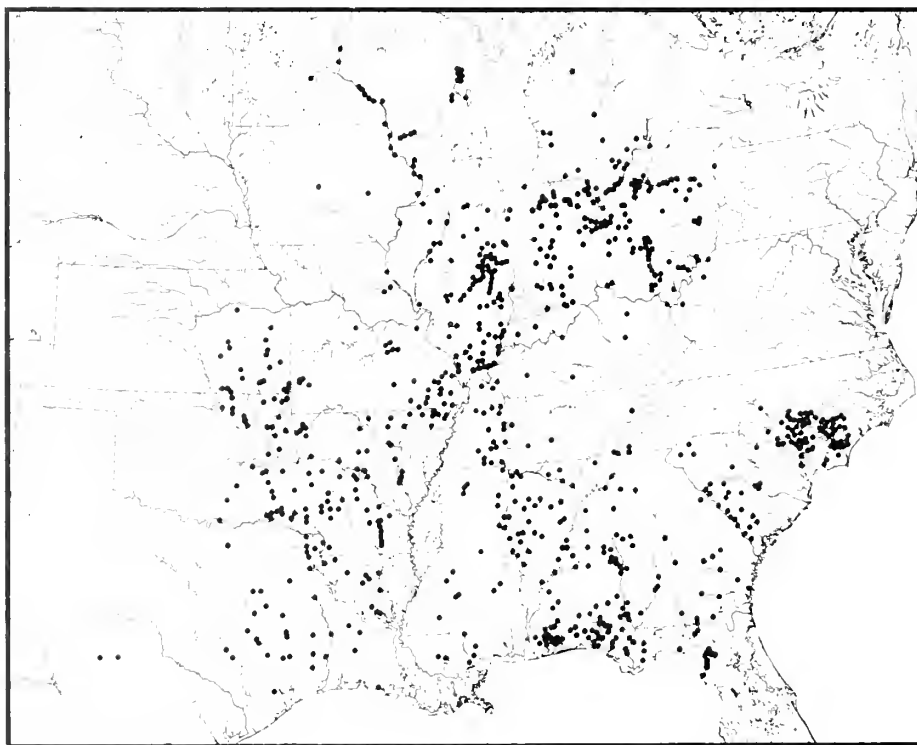
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Ohio River, at Louisville, KY (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Subfamily Catostominae. No definitive systematic study of infraspecific variation. Nelson (1948. J. Morphol. 83: 225-45), who studied morphology of Weberian apparatus in Catostomidae, considered most closely related to *Erimyzon*, and Miller (1959. Zoogeography. Am. Assoc. Adv. Sci. Publ. 51:187-222) showed relationship of these two genera (tribe Erimyzontini) to other catostomid groups.



AL: Macon Co., Tallapoosa River system, 204 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Lower Great Lakes basin (lakes Erie, Huron, and Michigan) of PA, OH, MI, WS, and ON; upper Mississippi Valley in WS, MN, and IA; south to Gulf slope drainages from TX (Colorado River drainage) to FL (Suwannee River drainage); and north on Atlantic coast to Cape Fear drainage of NC. Alleged records from eastern and western MD (Hildebrand and Schroeder 1928. Bull. U.S. Bur. Fish. 43:1-366; Schwartz 1964. Md. Conserv. 41:8-12) believed based on misidentifications. Typically in clear, firm-bottomed creeks and small rivers, but sometimes in small turbid creeks or overflow lakes and impoundments. Often moderately common, but has disappeared from certain areas (as in much of IL) where extensive siltation has occurred.

ADULT SIZE: 150-495 mm TL.

BIOLOGY: Several publications on various aspects of biology, particularly in OK (Hall

and Jenkins 1953. Okla. Fish. Res. Lab. Rept. 33:1-54; Jackson 1954. Proc. Okla. Acad. Sci. 35:10-14; Jackson 1958. Proc. Southeast. Assoc. Game Fish Comm. [1957] 11:232-49; Jenkins and Finnell 1957. Okla. Fish. Res. Rept. 59:1-46; Jackson 1966. Proc. Southeast. Assoc. Game Fish Comm. [1965] 19:315-43). McSwain and Gennings (1972. Trans. Am. Fish. Soc. 101:738-40) discussed spawning, and Hogue and Buchanan (1977. Trans. Am. Fish. Soc. 106: 347-53) discussed larval development. In OK, spawning occurred in late April and May at 15-18°C in riffle areas above pools. Eggs hatched in 7 to 12 days. Spawns in GA from early March to early May, at 12-19.5°C. Spawned in Ichetucknee Spring Run, FL, in early March (R.E. Jenkins, pers. comm.) Maximum age in MN was six years.

Compilers: C. R. Gilbert and G. H. Burgess. September 1979.

Morostoma anisurum (Rafinesque)
Silver redhorse

Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Ohio River and its large tributaries (Rafinesque 1820. West. Rev. Misc. Mag. 2:299-307).

SYSTEMATICS: Subgenus *Morostoma*. Phyletically aligned, though not closely, with *M. duquesnei*, *M. erythrum*, *M. pocillurum*, and the undescribed grayfin redhorse, based on genetic study by Buth (1978. Ph.D. diss., Univ. Illinois). Southern Atlantic slope populations tend as a group to differ racially from all others (Jenkins 1970. Ph.D. diss., Cornell Univ.).



NC: Orange Co., Eno River, 62 mm SL (NCSM).



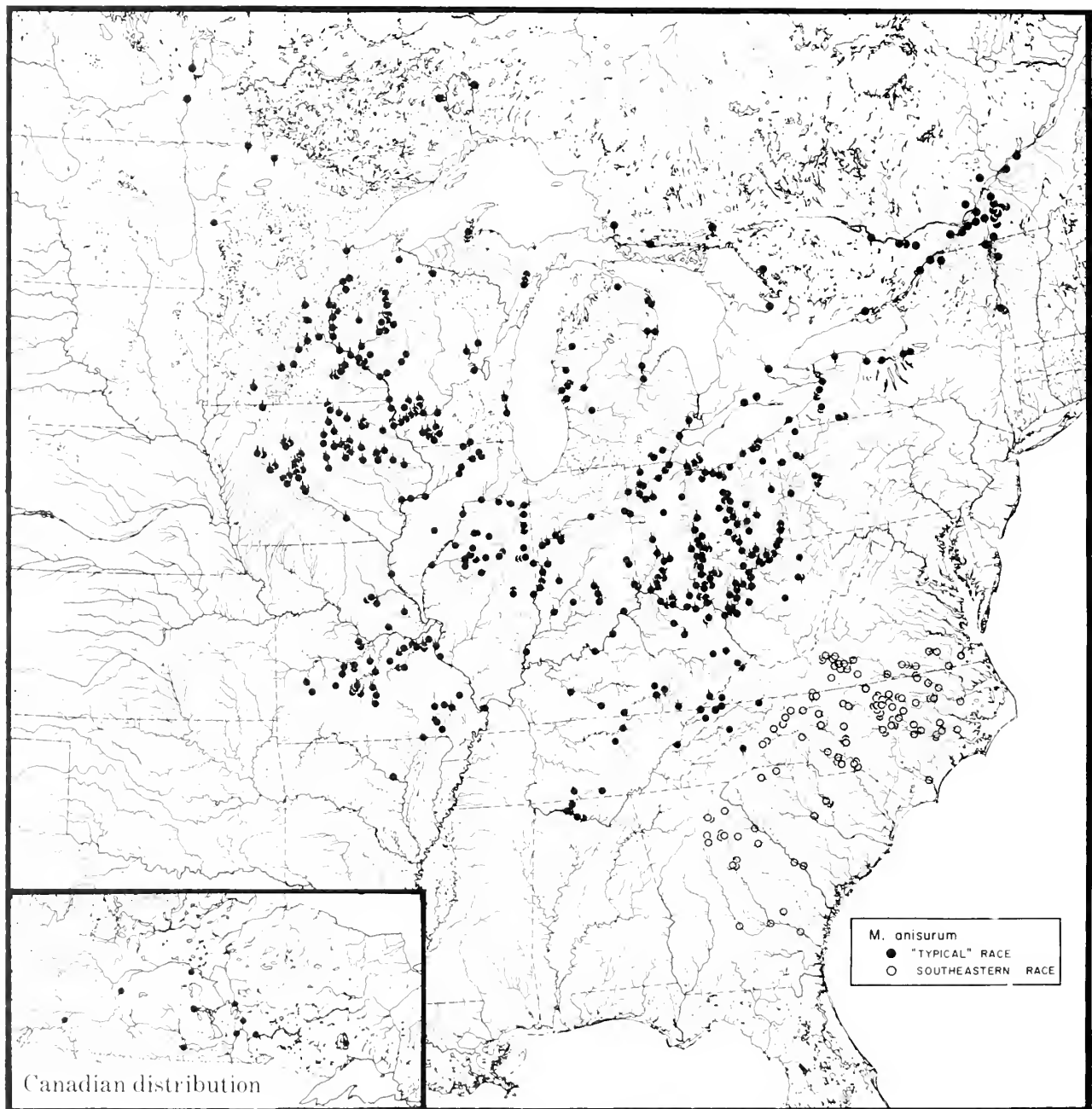
See map on next page

DISTRIBUTION AND HABITAT: Atlantic slope from Altamaha north to Roanoke-Chowan drainage, GA to VA (Dismal Swamp record, VA, questionable); nearly throughout Ohio basin; eastern and northern parts of Ozarkian uplands; widespread in upper Mississippi and Great Lakes — St. Lawrence basins, and Nelson River drainage of Hudson Bay drainage. Typically in silty to firm bottomed pools of large streams and rivers; often in moderate size streams in Southeast; also in natural lakes and impoundments. Rare to common.

ADULT SIZE: 250-400 mm SL, ca. 570 mm TL maximum.

BIOLOGY: Studied or compiled by Meyer (1962. Trans. Am. Fish. Soc. 94:412-19), Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), Jenkins (1970), Scott and Crossman (1973. *Freshwater Fishes of Canada*), and Smith (1977. Ph.D. diss., Ohio State Univ.). Aspects of sensory morphology discussed by Miller and Evans (1965. Copeia: 467-87). Diet mainly molluscs, immature insects, algae, and detritus. Mature at about five years. Spawns relatively early in spring, water ca. 13°C.

Compiler: R. E. Jenkins. February 1980.



Distribution of silver redhorse, *Morostoma anisurum*

Moreostoma ariommum Robins and
Raney
Bigeye jumprock

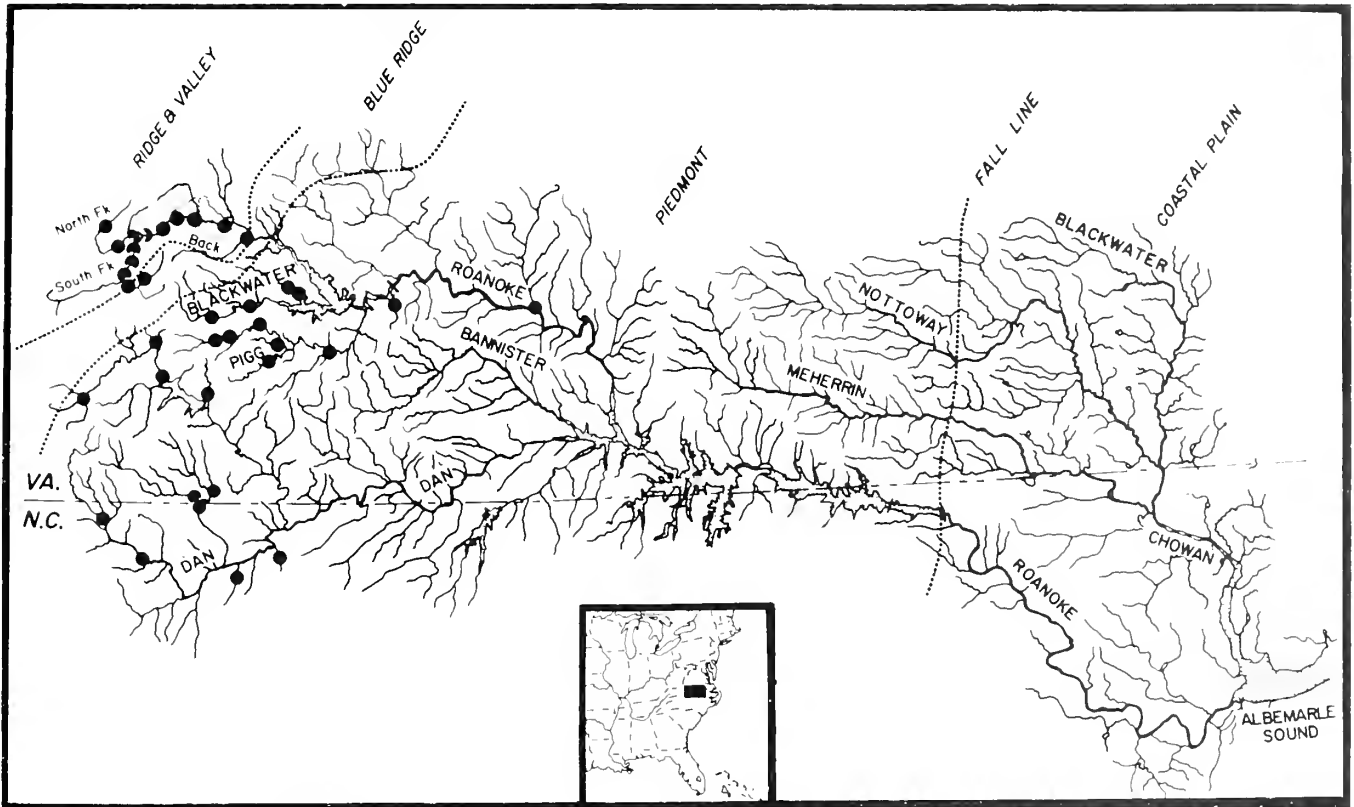
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: [South Fork] Roanoke River, 4 km sw of Shawsville, Montgomery Co., VA (Robins and Raney 1956, Cornell Univ. Agr. Exp. Sta. Mem. 343:1-56).

SYSTEMATICS: Subgenus *Scartomyzon*. Morphologically and genetically very distinct from other *Moreostoma* species (Robins and Raney 1956; Miller and Evans 1965, Copeia: 467-87; Jenkins 1970, Ph. D. diss., Cornell Univ.; Buth 1978, Ph. D. diss., Univ. Illinois). Thought by Jenkins (1970) to have stemmed from lineage that lead to *Thoburnia*, particularly *M. atripinne*, but Buth (1978) regarded it a member of *Scartomyzon*.



VA: Montgomery Co., South
Fork of Roanoke River,
143 mm SL (NCSM)



DISTRIBUTION AND HABITAT: Endemic to Roanoke drainage, VA and NC. Known in Roanoke proper and Dan systems from Ridge and Valley Province into upper half of Piedmont Province; range apparently discontinuous on Piedmont. Record for Chowan system (Jenkins et al. 1975, Va. J. Sci. 26:128-34) invalid, based on faulty locality data. Inhabitant of small to large usually medium-sized, warm, generally clear to moderately turbid, moderate gradient streams. Larger juveniles and adults typically congregate in deep runs and head of pools, usually among large rubble, boulders and outcrop; occasionally found in shallow riffles and flowing parts of pools distant from their head. Young generally in pools. Usually uncommon, never abundant.

ADULT SIZE: 110-190 mm SL.

BIOLOGY: Aspects of sensory morphology studied by Miller and Evans (1965). Diet of eight large juveniles and adults mainly chironomid larvae; usually much lesser numbers of other immature insects such as other diptera, particularly the tipulid *Antocha*, plecoptera, ephemeroptera, and trichoptera. Seven of these specimens consumed water mites. Apparently spawns in March, based on gonadal and tubercle development.

Compilers: R. E. Jenkins and P. H. Lahrman.
July 1979.

Moostoma atripinne Bailey
Blackfin sucker

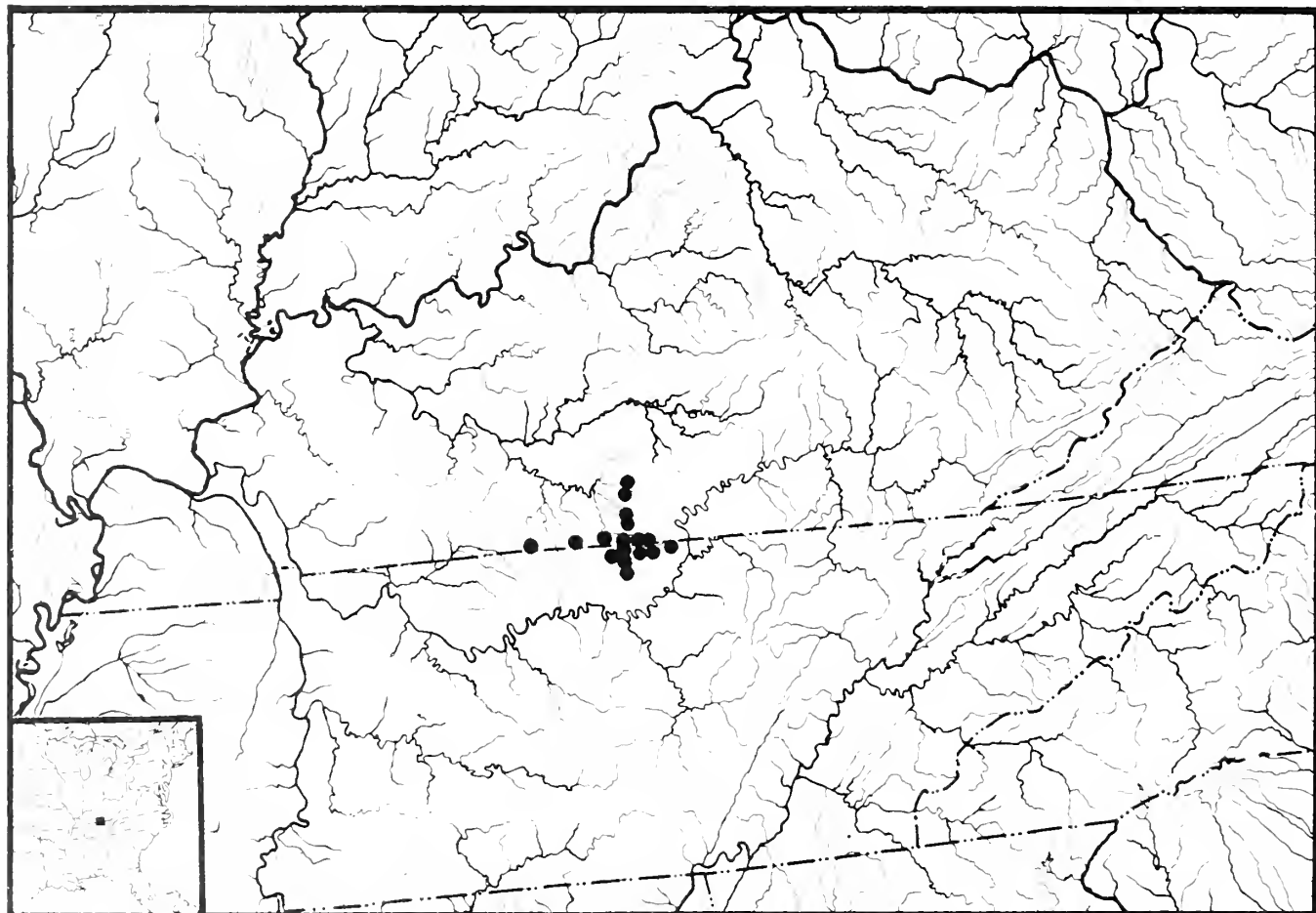
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Salt Lick Creek, tributary Long Fork of Barren River system (Green River drainage), at Red Boiling Springs, Macon Co., TN (Bailey 1959, Occas. Pap. Mus. Zool. Univ. Mich. 599: 1-19).

SYSTEMATICS: Subgenus *Thoburnia*. Highly distinctive species whose small range is quite disjunctive from that of other two species of *Thoburnia* (Bailey 1959; Jenkins 1970, Ph.D. diss., Cornell Univ.).



TN: Clay Co., Big Trace Creek.
76 mm SL (R. T. Bryant, Jr.).



DISTRIBUTION AND HABITAT: Restricted to headwater streams of Barren River near KY-TN boundary. Common (but often localized) in small to medium-sized streams with warm clear water, moderate current, gravel to rubble bottom, and alternating pools and riffles. Aggregations of adults sought shelter from seiners along shorelines with overhanging brush or moved into crevices in bedrock and under boulders.

ADULT SIZE: 100-146 mm SL.

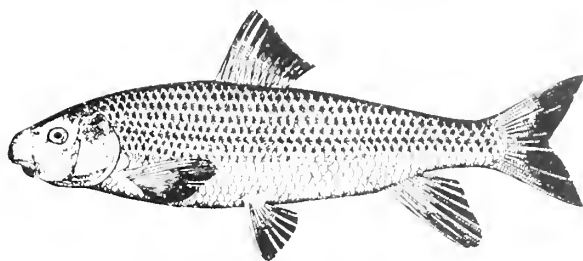
BIOLOGY: Bailey (1959) included notes on reproduction and habitat. Timmons et al. (1976, Abstract ASB Bull. 23:99; and in prep.) examined food, age, growth, and habitat. Spawns in mid-spring. Juveniles and adults feed primarily on chironomid larvae and cladocerans. Females attain larger size than males. Most older fish in fourth year of life. Timmons and Rogers (1977, J. Parasitol. 63: 238-39) described monogenean parasite, *Dactylogyrus atripinnei*, unique to this sucker.

Compilers: T. J. Timmons and J. S. Ramsey.
May 1979.

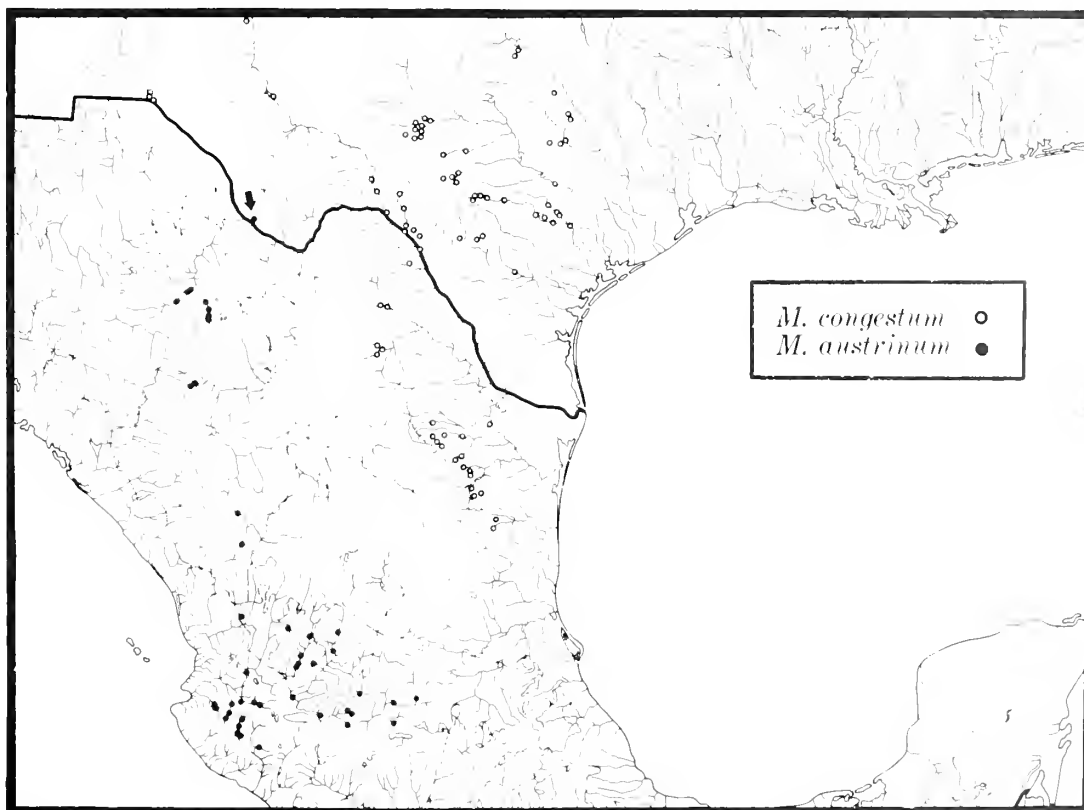
Morostoma austrinum (Bean)
West Mexican redbhorse
(proposed herein)

Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: (Rio Lerma system) at Piedad, Morelia (= Michoacan), Mexico (Bean 1880, Proc. U.S. Natl. Mus. 2:302-05).
SYSTEMATICS: Subgenus *Scartomyzon*. Most closely related to *M. congestum* (Robins and Raney 1957, Tulane Stud. Zool. 5:291-318; Jenkins 1970, Ph.D. diss., Cornell Univ.; Buth 1978, Ph.D. diss., Univ. Illinois). Subspecies *M. a. milleri* recognized (Robins and Raney 1957) from Mezquital system, Rio San Pedro drainage, Durango, Mexico. Form in Ameca drainage, Jalisco and Nayarit, recognized as species *M. mascotae* by Robins and Raney (1957), but regarded as conspecific with *M. austrinum* in biochemical study by Buth (1978) and as probably conspecific in morphological study underway by Jenkins. *Morostoma austrinum* shows about the greatest morphological variation of all *Morostoma* species.



Mexico: Morelia at Piedad (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Pacific slope of Mexico in Rio Armeria, Rio Ameca, Rio Grande de Santiago, and Rio San Pedro drainages. Atlantic slope, Rio Grande drainage, in Rio Conchos system, Chihuahua and Durango, Mexico, and Alamito Creek, Big Bend region, TX; last two populations formerly identified as *M. congestum*. Occupies small to large streams. Scant information available on preferred habitat. Specimens found around rocks and boulders in torrential rapids of stream that may seasonally

dry to isolated pools; others from moderately swift water (C. D. Barbour, pers. comm.).

ADULT SIZE: apparently varies among populations, some 115-250 mm SL; 380 mm SL maximum known.

BIOLOGY: Aspects of sensory morphology noted by Miller and Evans (1965, Copeia: 467-87). Spawns in spring, based on nuptial tuberculation.

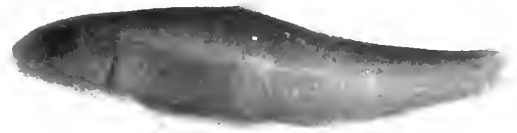
Compiler: R. E. Jenkins, July 1979.

Moxostoma carinatum (Cope)
River redhorse

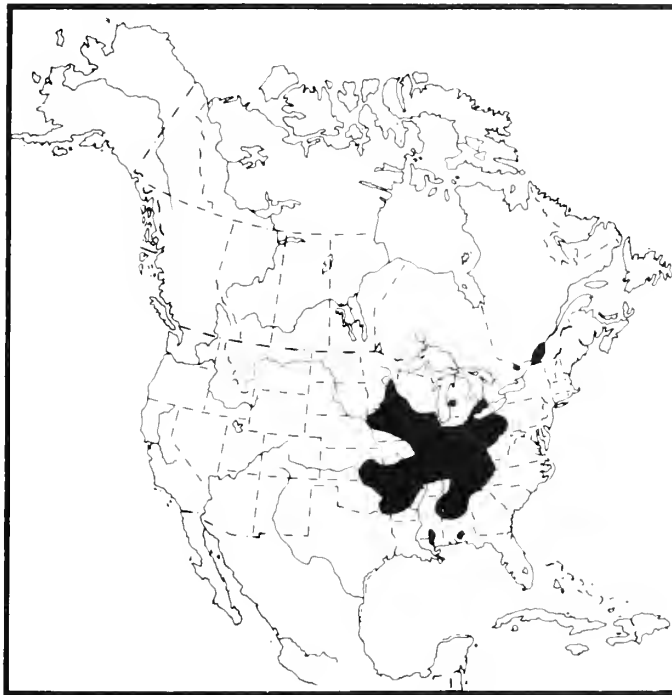
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Wabash River at Lafayette, IN (Cope 1870. Proc. Am. Philos. Soc. 11:448-95).

SYSTEMATICS: Subgenus *Moxostoma*. Formerly accorded monotypic generic status as *Placopharynx*. On basis of morphology, thought most closely related to *M. erythrum* (Jenkins 1970. Ph.D. diss., Cornell Univ.), but genetic study of Buth (1978. Ph.D. diss., Univ. Illinois) placed it closer to *M. macrolepidotum*. Systematics reviewed by Jenkins (1970); pharyngeal structure described by Eastman (1977. Am. Midl. Nat. 97:68-88).



FL: Escambia River, 73 mm
SL (NCSM).



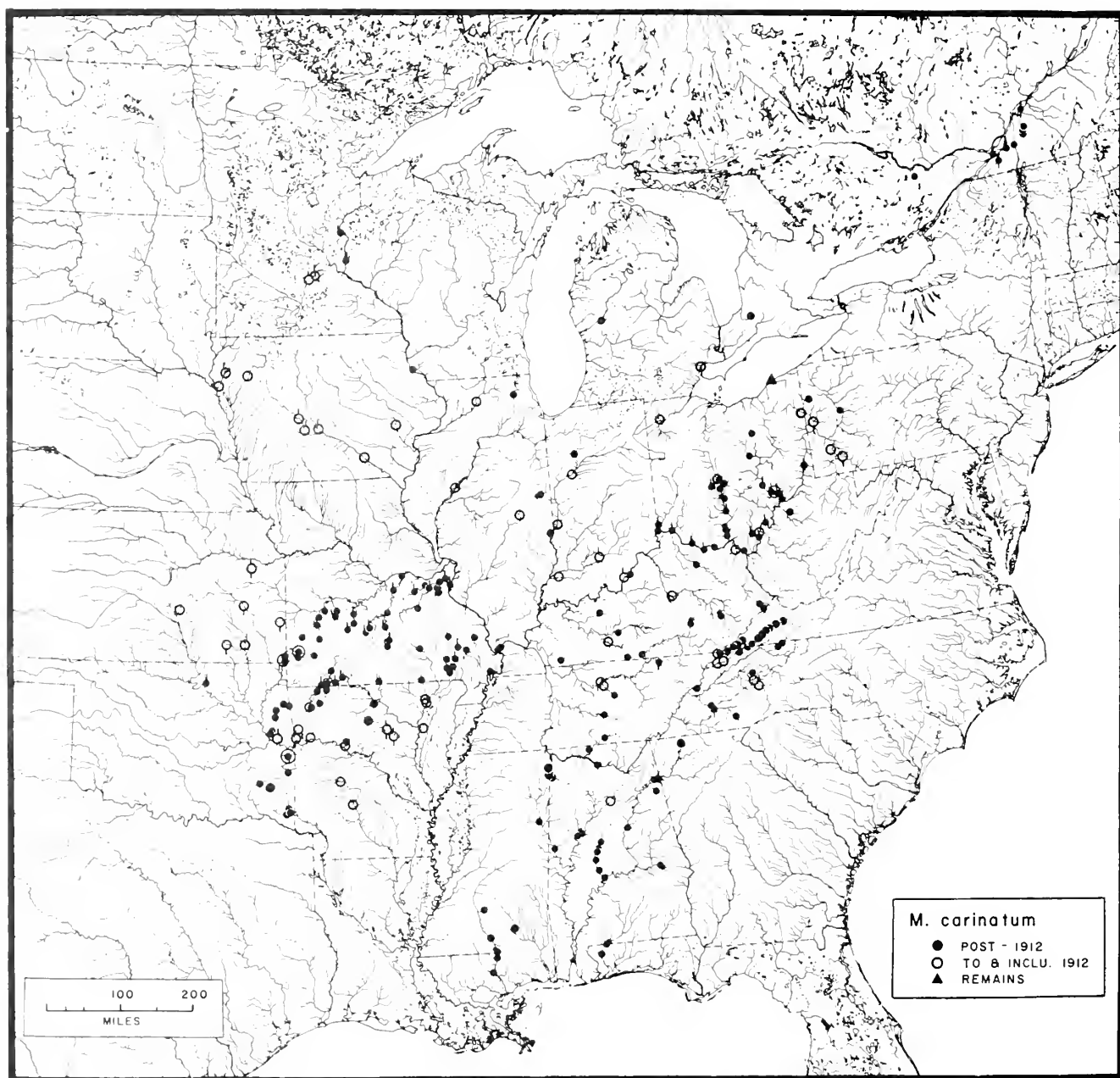
See map on next page

DISTRIBUTION AND HABITAT: Eastern Gulf slope from Pearl to Escambia drainage, LA to FL; widely in central Mississippi basin, mostly uplands, OK to NC, north to MN and PA; few Great Lakes basin records: lakes Michigan, Huron, and Erie; also Ottawa and St. Lawrence drainages. Unknown recently from many areas in western and northern parts of range. Generally confined to clearer large streams and rivers; occasionally in reservoirs. Usually uncommon or rare, occasionally common.

ADULT SIZE: ca. 360-600 mm SL.

BIOLOGY: Summarized by Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), Jenkins (1970), and Scott and Crossman (1973. *Freshwater Fishes of Canada*). Feeds on molluscs, for which it is specialized, and aquatic insect larvae. Longevity to 12 years. Spawns in spring, on shoals and in runs, water 22-25°C. Construction of large redd, and swimming display, by males are unique activities among catostomids (Hackney et al. 1968. Proc. 21st Ann. Conf. Southeast. Assoc. Game Fish. Comm.:324-32; Hackney ms.).

Compiler: R. E. Jenkins. February 1980.



Distribution of river redhorse, *Morostoma carinatum*

Moxostoma cervinum (Cope)
Black jumprock

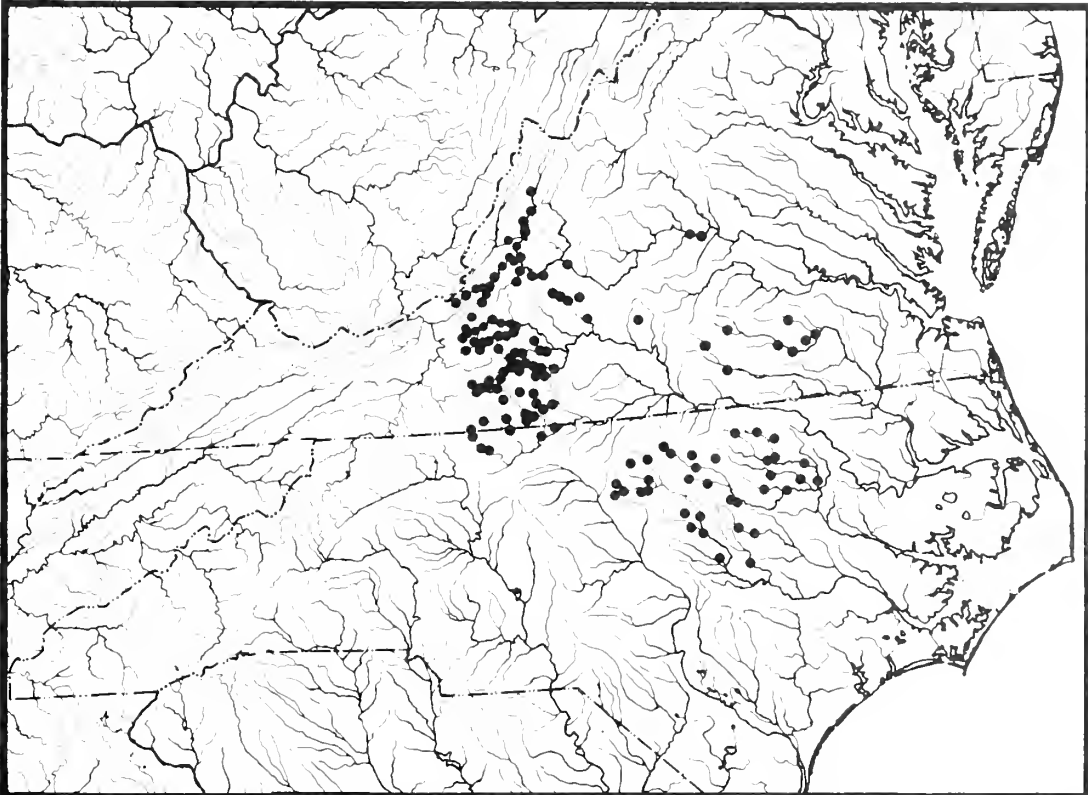
Order Cypriniformes
Family Catostomidae



NC: Johnston Co., Swift Creek,
87 mm SL (NCSM).

TYPE LOCALITY: "head-waters of the Roanoke and James Rivers, Va." (Cope 1868, J. Acad. Nat. Sci. Phila. [Ser. 2] 6:207-47). James drainage "types" are *M. rhothoecum*; locality restricted to Roanoke drainage (Raney and Lachner 1946, Copeia: 218-26; Robins and Raney 1956, Cornell Univ. Agr. Exp. Sta. Mem. 343: 1-56). Locality probably in Montgomery Co., as Cope known to have collected only there in Roanoke drainage.

SYSTEMATICS: Subgenus *Scartomyzon*. Considered a relatively primitive member of group (Jenkins 1970, Ph.D. diss., Cornell Univ.), near *M. lachneri* (Buth 1978, Ph.D. diss., Univ. Illinois). Systematics reviewed by Robins and Raney (1956), who found racial differences between Tar-Neuse and Roanoke-James groups. Additional aspects of morphology treated by Jenkins (1970).



DISTRIBUTION AND HABITAT: Widely distributed in Piedmont and upper Coastal Plain of Neuse and Tar drainages, NC. Largely restricted to mountains and upper Piedmont in Dan and Roanoke systems of Roanoke drainage, NC and VA. Lower Piedmont to Fall Line in Chowan system, Roanoke drainage, VA. First records for James drainage in 1951 from Craig Creek system, VA, thought reached by stream capture (Robins and Raney 1956; Lachner and Jenkins 1971, Smithsonian Contrib. Zool. 85:1-97). However, more recent records above and far below Craig Creek suggest dispersal

after human introduction. Prefers medium to large size, warm, usually clear, moderate gradient streams. Juveniles and adults usually in runs and riffles of gravel to boulder; young largely in pools. Uncommon to common.

ADULT SIZE: 90-164 mm SL.

BIOLOGY: Aspects of sensory morphology treated by Miller and Evans (1965, Copeia: 467-87). Benthic feeder, often in groups. Apparently spawns in May, based on gonadal and nuptial tubercle development.

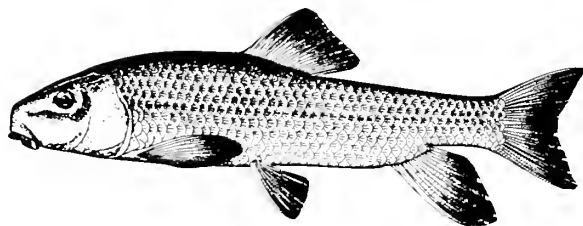
Compiler: R. E. Jenkins, July 1979.

Moxostoma congestum (Baird and
Girard)
Gray redhorse

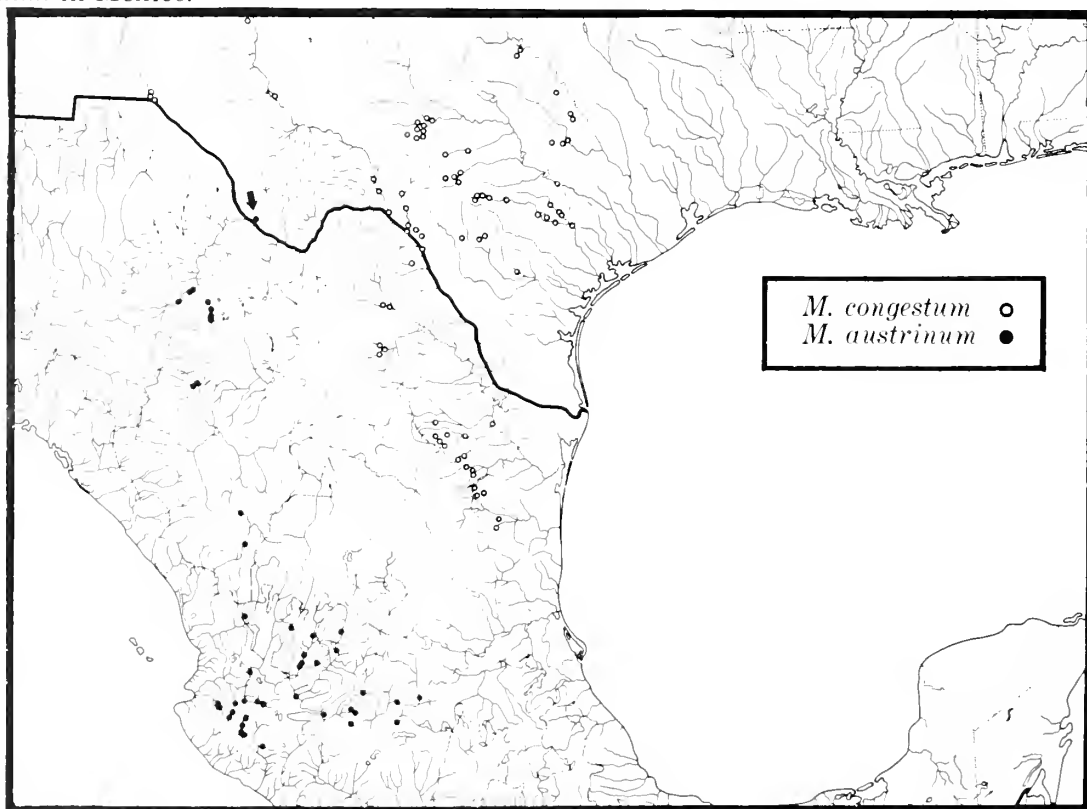
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Rio Salado, TX (Baird and Girard 1854. Proc. Acad. Nat. Sci. Phila. [1854-55] 7:24-29).

SYSTEMATICS: Subgenus *Scartomyzon*. Most closely related to *M. austrinum* (Robins and Raney 1957. Tulane Stud. Zool. 5:291-318; Jenkins 1970. Ph.D. diss., Cornell Univ.; Buth 1978. Ph.D. diss., Univ. Illinois). Affinity of these species with *M. robustum* (Robins and Raney 1956. Cornell Univ. Agr. Exp. Sta. Mem. 343:1-56; Robins and Raney 1957; Jenkins 1970) more distant than previously thought, based on genetic study by Buth (1978). Two subspecies recognized by Robins and Raney (1975); nominate form in TX and NM, and *M. c. albidum* in Mexico.



TX: Rio Lampasas, Belton, ca. 47 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: In United States, Brazos drainage west to Pecos system of Rio Grande drainage, TX and southeastern NM, and Rio Grande in vicinity of El Paso, TX; largely in Edwards Plateau region and its escarpments. In Mexico, Rio Grande tributaries below Big Bend region, and south on Atlantic slope to Rio Sota la Marina drainage, Tamaulipas. Range excludes Alamito system in Big Bend region, TX, and Conchos system, Chihuahua, Mexico, both of Rio Grande drainage, based on reidentifications of *M. austrinum*. Tornillo Creek specimens, Big Bend region, reported as *M. congestum* (Hubbs and Wauer 1973. Southwest. Nat.

17:375-79), unavailable for study. Inhabits medium to large, warm, usually clear streams. Adults typically in pools over rock, gravel, sand, and silt; sometimes in deep runs. Juveniles and young often in riffles and gravelly runs. Also known from a few lakes in TX. Rare to abundant.

ADULT SIZE: 230-325 mm SL in present study; 514 mm SL maximum.

BIOLOGY: Aspects of sensory morphology studied by Miller and Evans (1965. Copeia: 467-87). Spawns in spring, based on nuptial tuberculation.

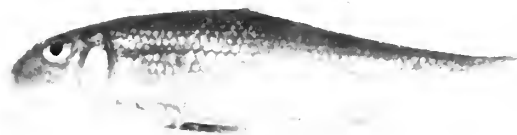
Compiler: R. E. Jenkins. July 1979.

Moxostoma duquesnei (Lesueur)
Black redhorse

Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: [Upper Ohio River basin] at Fort Duquesne [=Pittsburgh], PA (Lesueur 1817. J. Acad. Nat. Sci. Phila. 1:102-11).

SYSTEMATICS: Subgenus *Moxostoma*. Grouped phyletically with *M. poecilurum*, *M. anisurum*, *M. erythrurum*, and the undescribed grayfin redhorse (Buth 1978. Ph.D. diss., Univ. Illinois). Mobile drainage population racially distinct from all other populations (Jenkins 1970. Ph.D. diss., Cornell Univ.).



KY: Clay Co., South Fork of Kentucky River, 106 mm SL (NCSM).



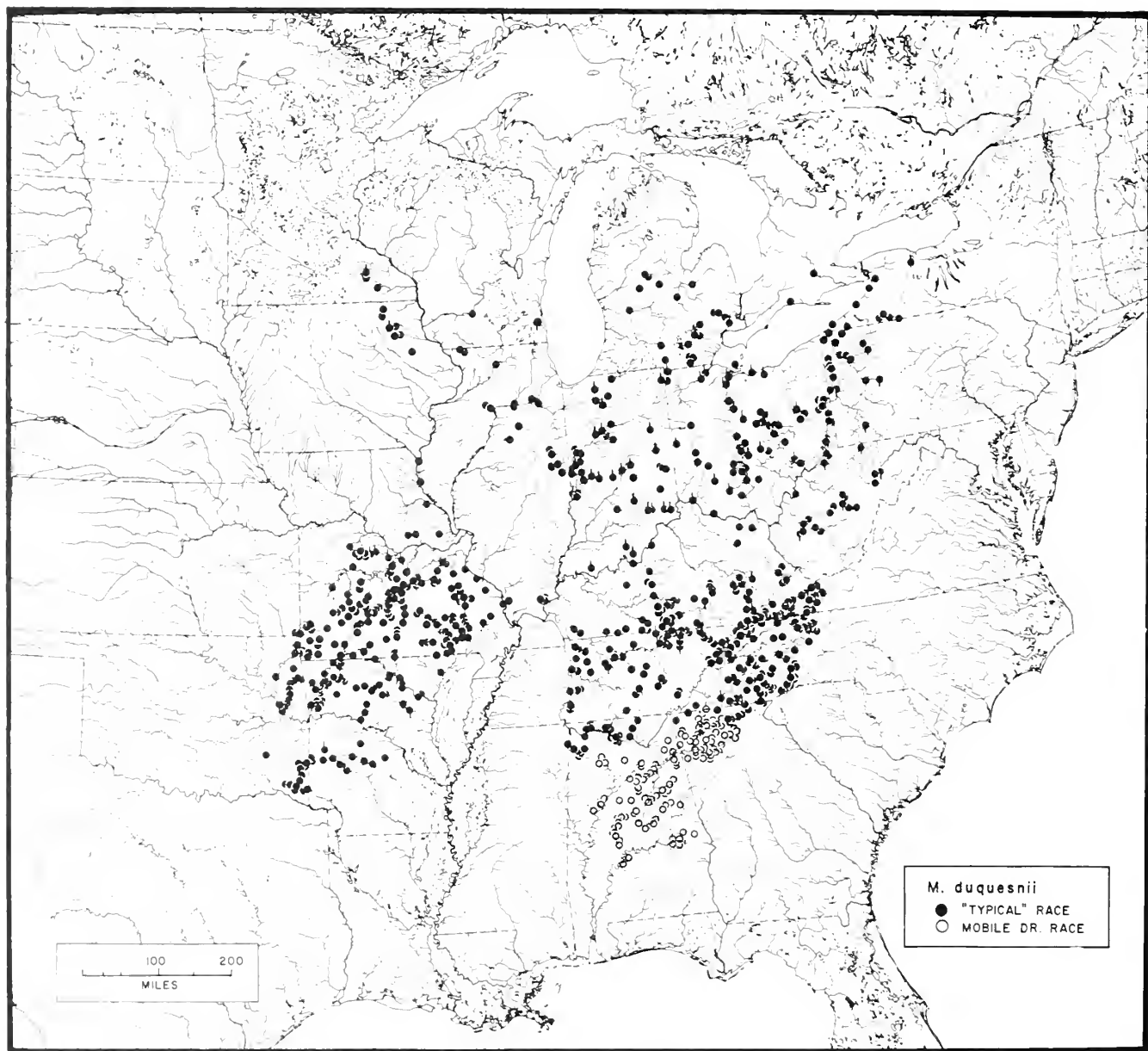
See map on next page

DISTRIBUTION AND HABITAT: Widespread in upper and middle Mobile drainage, but absent from Tombigbee system; throughout uplands and outliers of southern Ohio basin and Ozarks; many populations in northern Ohio basin and north into middle part of upper Mississippi basin; southern Great Lakes basin, in drainages of lakes Michigan, Huron, and Erie, and Genesee system of Lake Ontario. Avoids lowlands of central Mississippi basin, as do most other redhorses. Typical of medium to large size, gravelly to rocky, occasionally sandy and silty streams and rivers; prefers pools. Rarely in impoundments. Often common.

ADULT SIZE: 170-400 mm SL.

BIOLOGY: Studied or compiled by Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), Bowman (1970. Trans. Am. Fish. Soc. 99:546-59), Jenkins (1970), Scott and Crossman (1973. *Freshwater Fishes of Canada*), and Smith (1977. Ph.D. diss., Ohio State Univ.). Some aspects of sensory morphology treated by Miller and Evans (1965. Copeia: 467-87). Diet mainly microcrustaceans, aquatic insects, detritus, and algae. Matures in 2-5 years; maximum longevity 10 years. Spawns in gravel and fine rubble runs and riffles during spring, water 13-23°C.

Compiler: R. E. Jenkins. February 1980.



Distribution of black redhorse, *Morostoma duquesnei*

Morostoma erythrurum (Rafinesque)
Golden redhorse

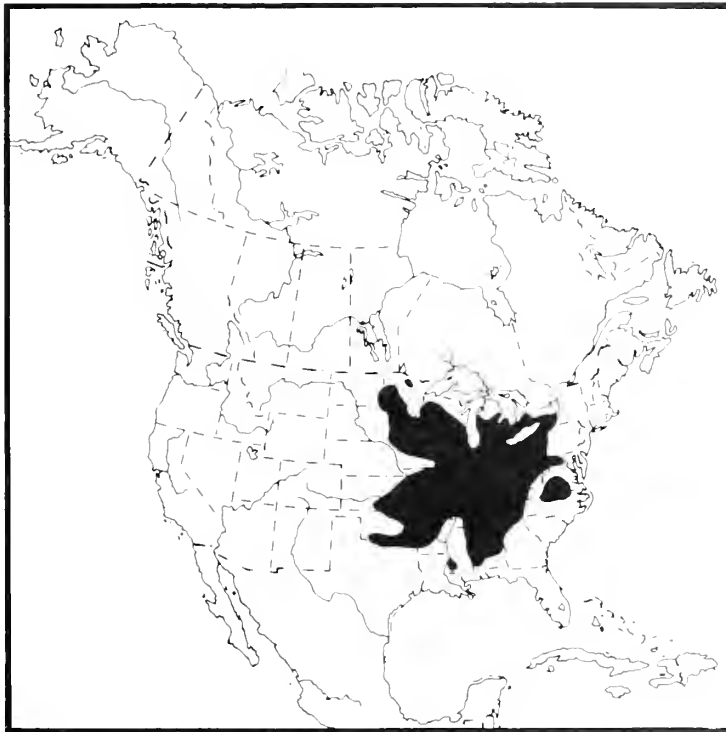
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Not fixed; described from several drainages of Ohio River basin (Rafinesque 1820. West. Rev. Misc. Mag. 2:299-307).

SYSTEMATICS: Subgenus *Morostoma*. Allied with *M. duquesnei*, *M. anisurum*, *M. poecilurum*, the undescribed grayfin redhorse (Buth 1978. Ph.D. diss., Univ. Illinois), and perhaps with *M. carinatum* (Jenkins 1970. Ph.D. diss., Cornell Univ.). Racial divergence most prominent in Tallapoosa system of Mobile drainage.



NC: Mitchell-Yancey cos.,
Nolichucky River, 138 mm SL
(NCSM).



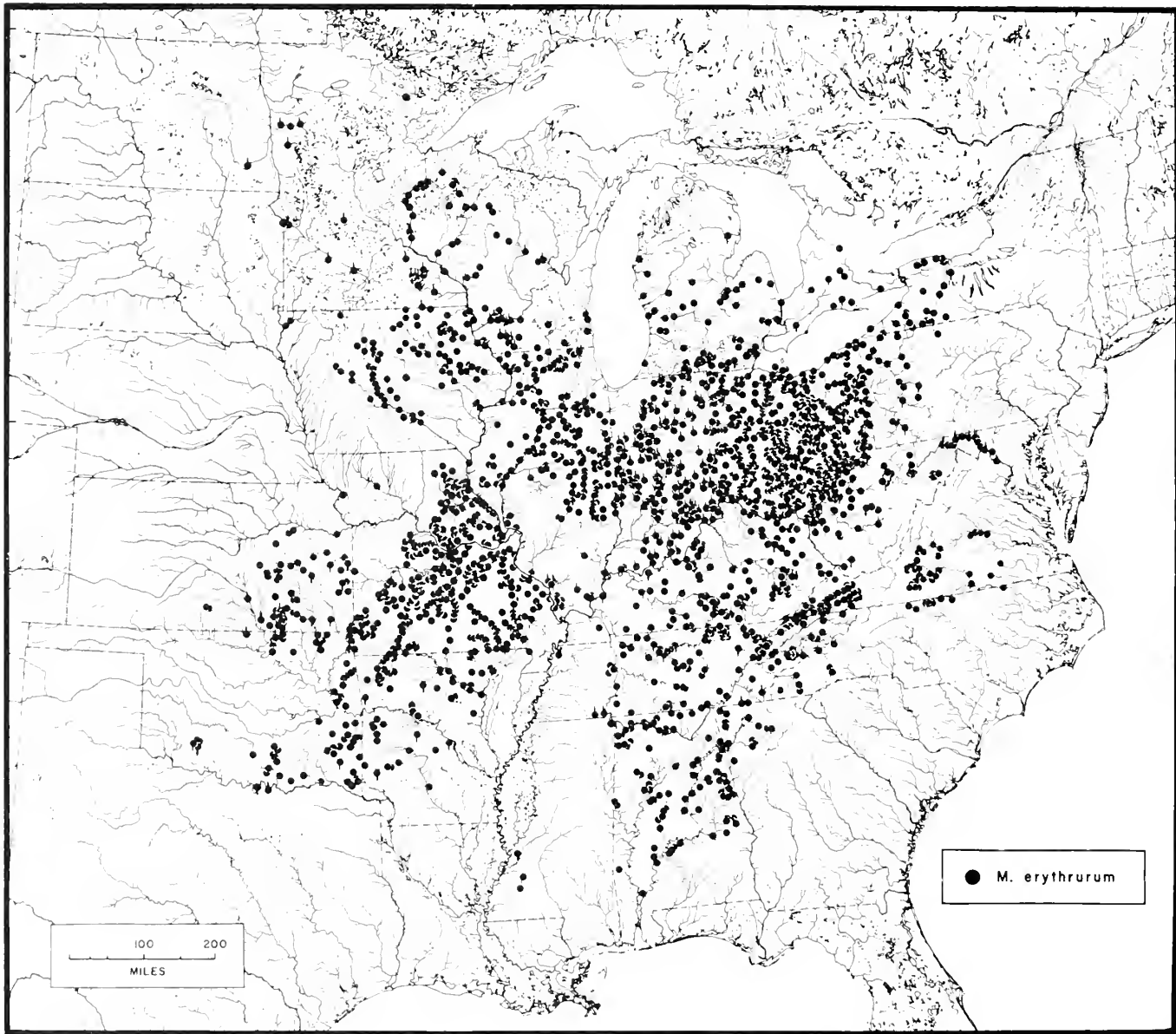
See map on next page

DISTRIBUTION AND HABITAT: Widely distributed in Mobile drainage of Gulf slope, Mississippi, Ohio, and lower Missouri basins, southern Great Lakes basin excluding Lake Superior drainage, upper Red River of North and Lake of the Woods drainage, and Roanoke and James drainages on Atlantic slope. Recently found, perhaps introduced, in Potomac drainage. Avoids lowlands of central Mississippi Valley; relict populations in southwest MS. Inhabits small to large streams and rivers with varied substrate; generally in pools, often over sand or silt. Occasionally in lakes. Often common.

ADULT SIZE: 185-390 mm SL, ca. 660 mm TL maximum.

BIOLOGY: Some aspects of sensory structure described by Miller and Evans (1965. Copeia:467-87). Biology studied or summarized by Meyer (1962. Trans. Am. Fish. Soc. 94:412-19), Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1), Jenkins (1970), Scott and Crossman (1973. *Freshwater Fishes of Canada*), and Smith (1977. Ph.D. diss., Ohio State Univ.). Feeds mostly on small molluscs, microcrustaceans, insects, detritus, and algae. Matures in 3-5 years, lives to eight years. Spawns during spring in runs and riffles of largely gravel, water 17-22°C.

Compiler: R. E. Jenkins, February 1980.



Distribution of golden redhorse, *Morostoma erythrurum*

Morostoma hamiltoni (Raney and Lachner)
Rustyside sucker

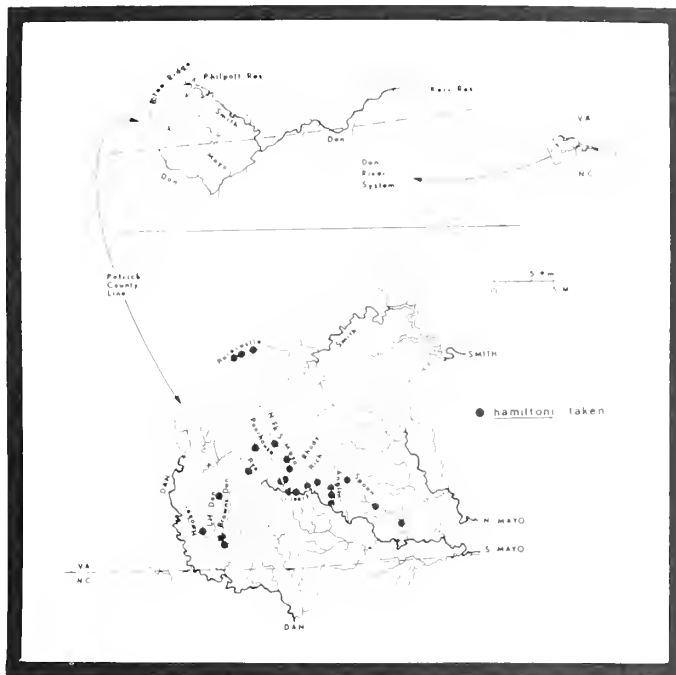
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Anglin Creek, tributary of South Mayo River, 1.6 km w of Patrick Springs, 5.6 km e of Stuart, U.S. 58, Patrick Co., VA (Raney and Lachner 1946. Copeia:218-26).

SYSTEMATICS: Subgenus *Thoburnia*. Very closely related to, and with *M. rhythoeum* forms *rhythoeum* species-group (Jenkins 1970. Ph.D. diss., Cornell Univ.); genetic differences between the two treated by Buth (1977. Biochem. Syst. Ecol. 5:57-60). *Morostoma atripinne* is third member of subgenus. Morphology and color of group suggest *Thoburnia* closely related to genus *Hypentelium* (Jenkins 1970), a view supported by genetic studies of Buth (1979. Comp. Biochem. Physiol. 63B: 7-12). Although *Thoburnia* reduced to subgenus by Bailey (1959. Occas. Pap. Mus. Zool. Univ. Mich. 599:1-19), Buth (1979) concluded that phyletically (cladistically) it merits generic status. Recognition as subgenus here is tentative.



VA: Patrick Co., Mayo River,
88 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Endemic to Dan River system of Roanoke drainage, where known only from Blue Ridge and outlying mountains in Patrick Co., VA. Elevation range 278 to 567 m above mean sea level. Three population groups well isolated by downstream distance and silty Piedmont habitat. Found in all three major subsystems of upper Dan — Smith, Mayo, and Dan proper — but only in small part of Smith and Dan and only in South Mayo. Population in upper Roanoke proper reidentified as *M. rhythoeum* (Jenkins 1970; Buth 1977). Prefers small, cold to warm, high gradient, usually clear streams. Larger juveniles and adults occupy runs and riffles of gravel, rubble, boulder and bedrock bottom; smaller juveniles also in flowing pools. Usually uncommon, but abundant at certain localities.

ADULT SIZE: 68-153 mm SL.

BIOLOGY: Aspects of sensory morphology studied by Miller and Evans (1965. Copeia: 467-87). Majority of gut contents of 30 specimens amorphous, flocculent organic matter; small numbers of immature mayflies, caddisflies, chironomids, and simuliids at intervals in gut of some specimens. Oldest males and females starting fifth year of life. Mature in two to four years, males generally sooner than females, and for both sexes sooner in faster growing populations. Spawning probably largely in April, based on gonadal condition and nuptial color and tubercles.

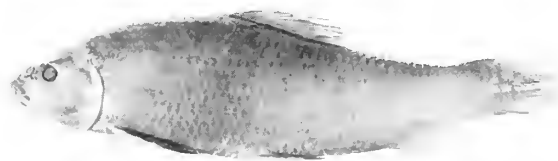
Compiler: R. E. Jenkins. July 1979.

Moxostoma hubbsi Legendre
Copper redhorse

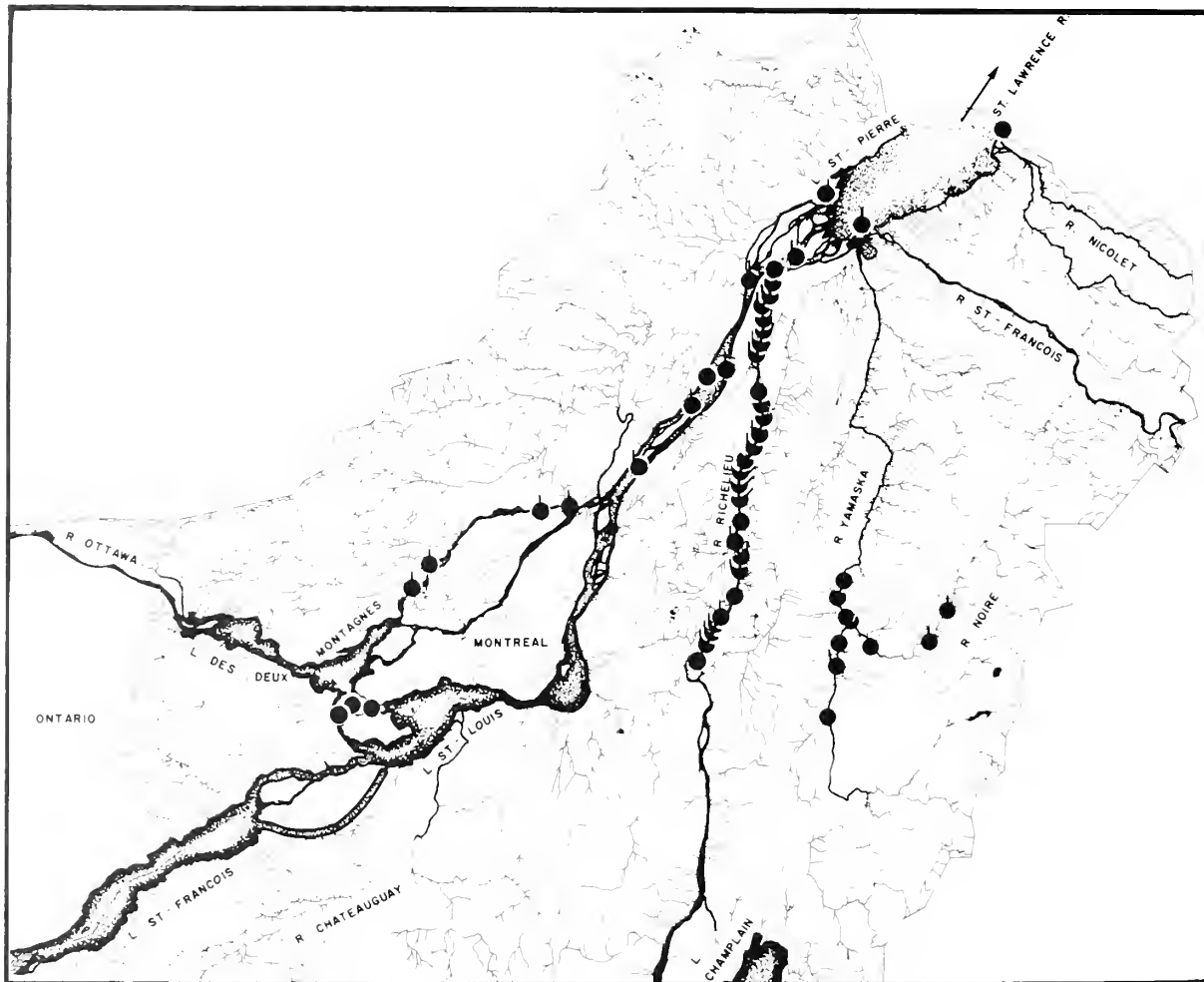
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: St. Lawrence River at west end of Montreal, QU (Legendre 1942. Nat. Can. 69:227-33). Lectotype and related nomenclatural problems discussed by Jenkins (1970. Ph.D. diss., Cornell Univ.).

SYSTEMATICS: Subgenus *Megapharynx*, with *M. valenciennesi*. Systematics reviewed by Jenkins (1970). Electrophoretic study by Buth (1978. Ph.D. diss., Univ. Illinois; 1979. Comp. Biochem. Physiol. 63B:7-12). Pharyngeal apparatus described by Eastman (1977. Am. Midl. Nat. 97:68-88).



QU: Chambly Co., 298 mm SL
(Que. Wildl. Serv.).



DISTRIBUTION AND HABITAT: Range very limited for a redhorse. Confined to St. Lawrence River and certain southern tributaries on Montreal Plain, from Montreal for ca. 150 km downstream to Lac Saint-Pierre, QU (Masse 1977. Minis. Tour., Chasse, Pêche, Direction Gen. Faune, Rep. 10:1-12). Occupies large rivers and some of their lakelike enlargements, with adults inhabiting swift sections of rivers at least around spawning time. Rare throughout range.

ADULT SIZE: ca. 380-570 mm SL.

BIOLOGY: Gut contents of one adult largely small bivalve and gastropod molluscs, which the species is specialized to crush; immature aquatic insects also consumed. Probably spawns in June, based on tubercle development.

Compiler: R. E. Jenkins. February 1980.

Morostoma lachneri Robins and Raney
Greater jumprock

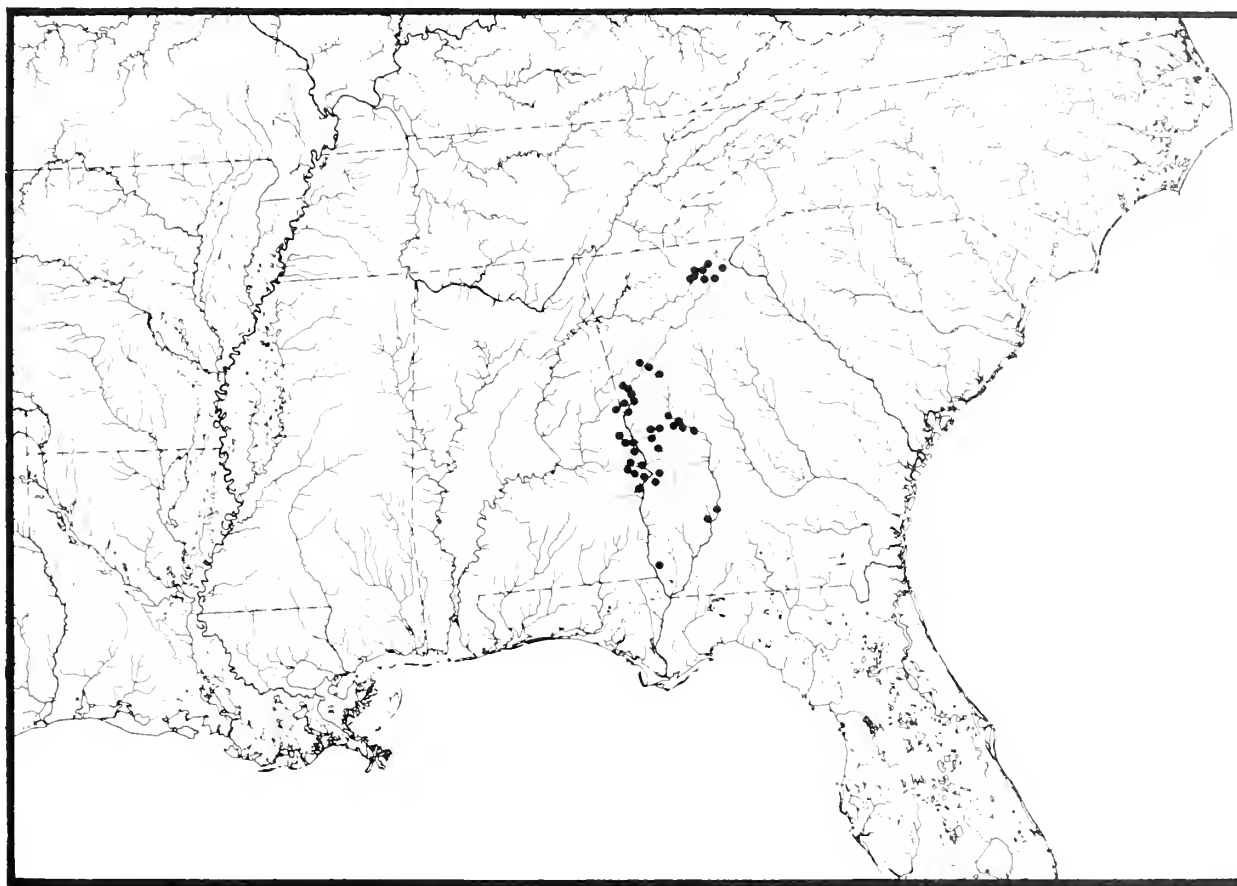
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Tributary of Hatcheechubbee Creek, 6.4 km sw of Seale, Russell Co., AL (Robins and Raney 1956, Cornell Univ. Agric. Exp. Sta. Mem. 343:1-56).

SYSTEMATICS: Subgenus *Scartomyzon*. Regarded most closely related to *M. rupis-cartes* by Robins and Raney (1956). From biochemical study Buth (1979, Ph.D. diss., Univ. Illinois) considered it relatively distantly related to that species, probably closer to *M. cecrinum*. Aspects of morphology treated by Robins and Raney (1956) and Jenkins (1970, Ph.D. diss., Cornell Univ.).



GA: Habersham-White cos.,
Chattahoochee River, 91mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Endemic to Apalachicola drainage, where widespread in Chattahoochee and Flint systems, AL and GA. In medium to large size streams and rivers, occupying areas of moderate to strong flow and substrates largely free of silt. Generally taken in small numbers, perhaps related to mobility of species.

BIOLOGY: Aspects of sensory morphology treated by Miller and Evans (1965, Copeia: 467-87). Spawmed in swift water in early June in northern GA (Burr 1979, Ga. J. Sei. 37:205-07).

ADULT SIZE: 195-375 mm SL.

Compiler: R. E. Jenkins. January 1980.

Morostoma macrolepidotum (Lesueur)
Shorthead redhorse

Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Supposedly from Delaware River (Lesueur 1817, J. Acad. Nat. Sci. Phila. 1:88-96), but either now extirpated from there, or locality erroneous and actual one unknown (Jenkins 1970, Ph.D. diss., Cornell Univ.).

SYSTEMATICS: Subgenus *Morostoma*. Considered most closely related to *M. carinatum* (Buth 1978, Ph.D. diss., Univ. Illinois). Three subspecies recognized (Jenkins 1970), with formerly widely recognized form *M. breviceps* reduced to subspecies and *M. auriculum* synonymized with *M. m. macrolepidotum* (Lachner 1967, Copeia:455-57).



MD: Washington Co., Potomac River, 97 mm SL (NCSM).



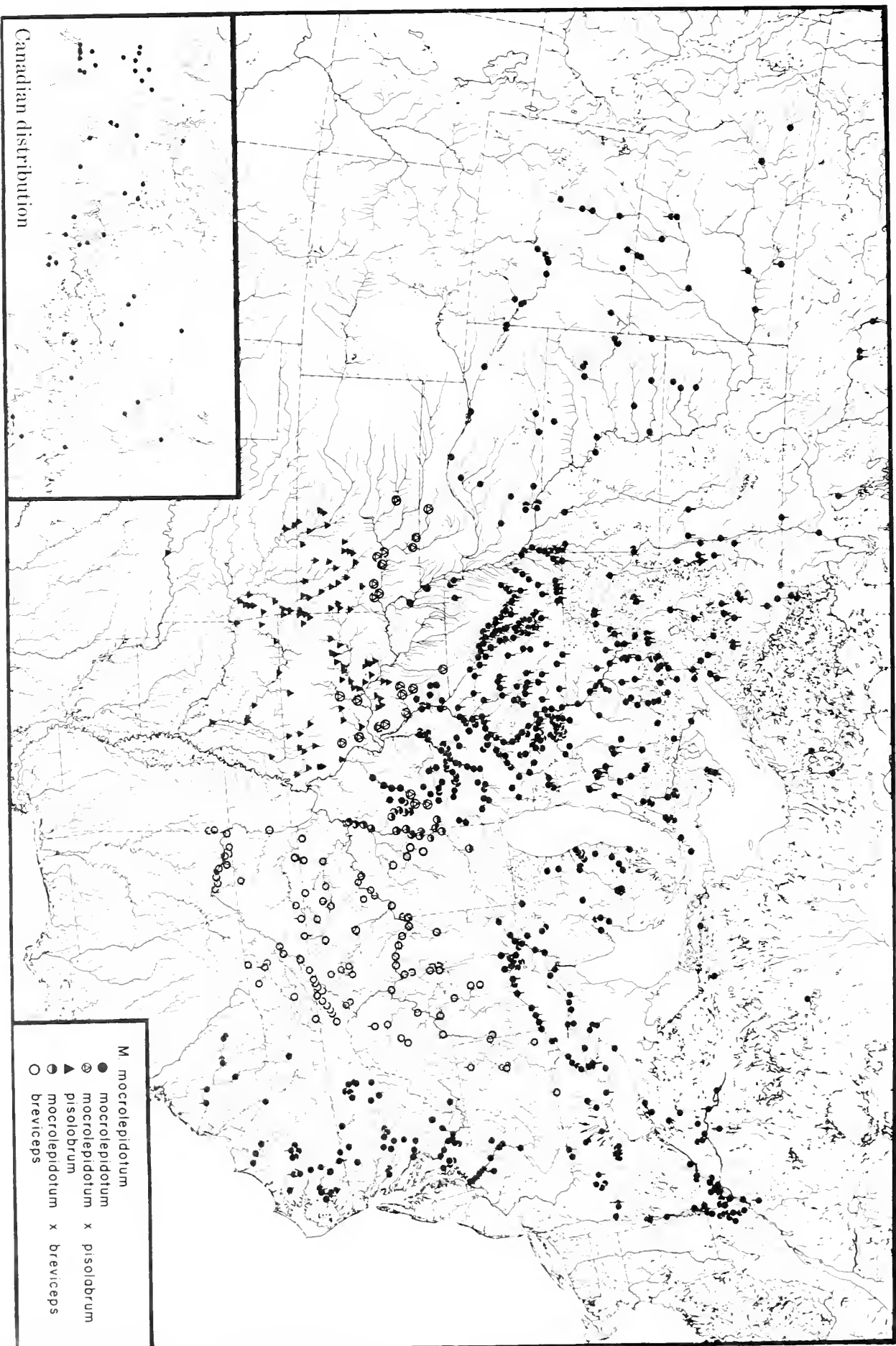
See map on next page

DISTRIBUTION AND HABITAT: *Morostoma m. breviceps* widespread in Ohio basin; *M. m. pisolabrum* in Ozark uplands and adjacent areas; *M. m. macrolepidotum* in most of remainder of Mississippi and Missouri basins, Great Lakes — St. Lawrence basin, many drainages of southwestern Hudson Bay basin, and on Atlantic slope from Santee drainage north to Hudson drainage, excluding perhaps Delaware River. Usually confined to large streams, rivers, natural lakes and impoundments. Rare to common.

ADULT SIZE: ca. 215-600, usually not exceeding 450 mm SL.

BIOLOGY: Studied by Meyer (1962, Trans. Am. Fish. Soc. 91:412-19); this and other works summarized by Carlander (1969, *Handbook of Freshwater Fishery Biology* Vol. 1), Jenkins (1970), and Scott and Crossman (1973, *Freshwater Fishes of Canada*). Consumes molluscs, microcrustaceans, and immature insects. Longevity to nine years. Spawns during spring, usually over gravel in runs and riffles, water 11-22°C (in part Burr and Morris 1977, Trans. Am. Fish. Soc. 106:80-81).

Compiler: R. E. Jenkins. February 1980.



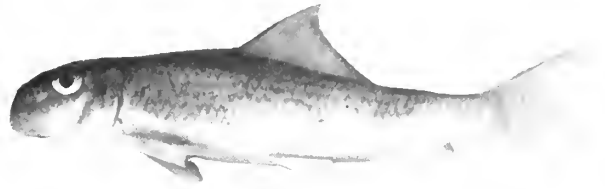
Distribution of shorthead redhorse, *Macrostomus macrochepidotum*

Morostoma pappillosum (Cope)
V-lip redhorse

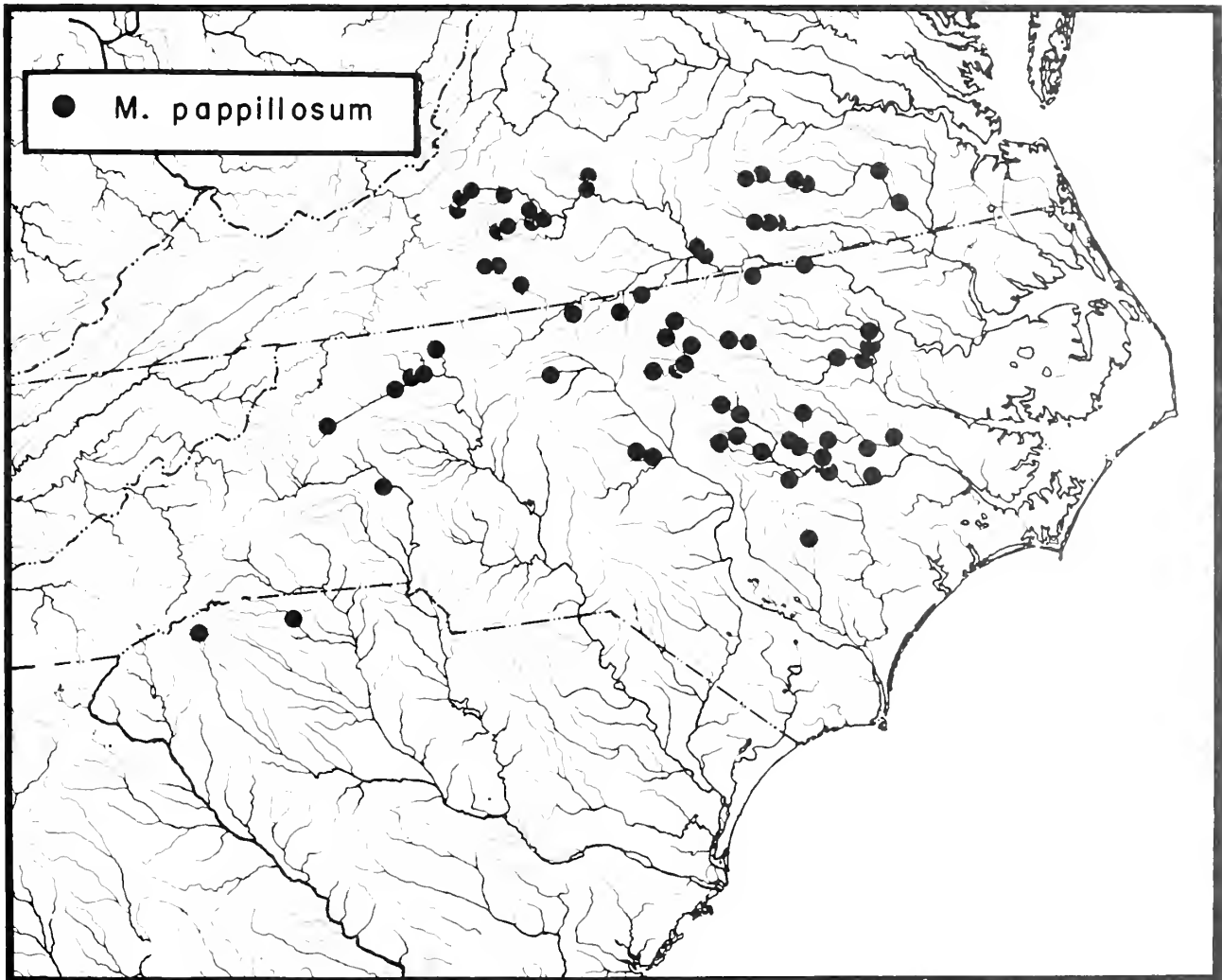
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Catawba (Santee drainage) and Yadkin (Pee Dee drainage) rivers, NC (Cope 1870. Proc. Am. Philos. Soc. 11:448-95).

SYSTEMATICS: Subgenus *Morostoma*. Clusters phenetically and genetically with *M. macrolepidotum* and *M. carinatum* (Robins and Raney 1956. Cornell Univ. Agric. Exp. Stan. Mem. 343; Buth 1978. Ph.D. diss., Univ. Illinois). Distinctive monotypic species (Jenkins 1970. Ph.D. diss., Cornell Univ.).



NC: Wake Co., Upper Barton's Creek, 98 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Atlantic slope from Santee drainage, SC, to Roanoke-Chowan drainage, VA. In silty to firm bottomed pools of medium-sized streams to rivers; occasionally in impoundments. Observed feeding in slow, gravel-bottomed run. Rare to common.

ADULT SIZE: 210-360 mm SL.

BIOLOGY: Certain aspects of sensory structure discussed by Miller and Evans (1965. Copeia:467-87). Probably a relatively late-spawning redhorse, in late spring-early summer, based on gonad and tubercle development.

Compiler: R. E. Jenkins. February 1980.

Morostoma poecilurum (Jordan)
Blacktail redhorse

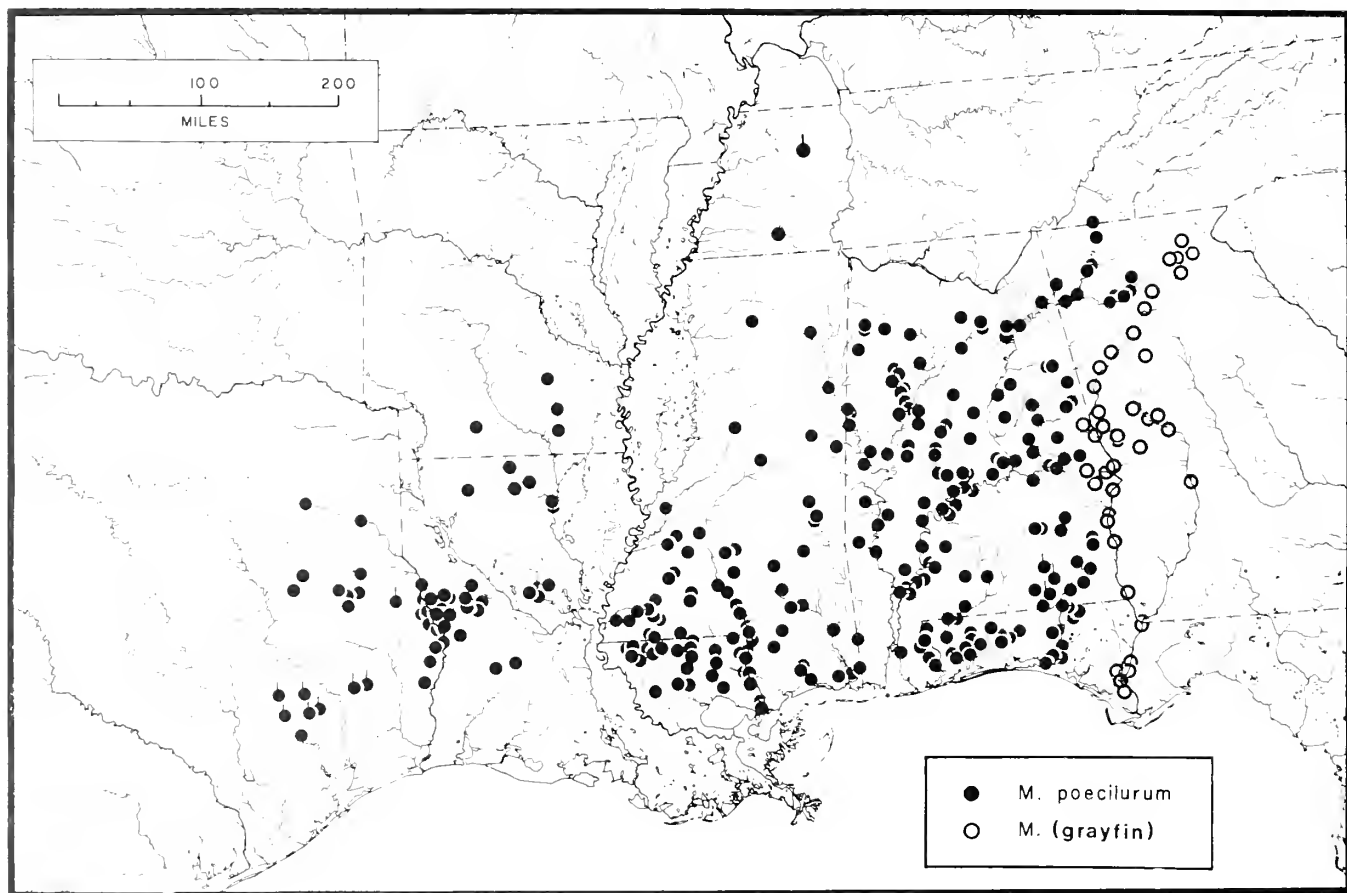
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Tangipahoa River, LA
(Jordan 1877. U.S. Natl. Mus. Bull. 10:1-68).

SYSTEMATICS: Subgenus *Morostoma*. From structure and color, most closely related to the undescribed grayfin redhorse (Jenkins 1970. Ph.D. diss., Cornell Univ.). Genetic study (Buth 1978. Ph.D. diss., Univ. Illinois) also suggests these are full species, only loosely related to each other, and to *M. duquesnei*, *M. erythrurum*, and *M. anisurum*.



AL: Lee Co., Tallapoosa River system, young, 105 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Gulf slope from Galveston Bay tributaries, TX to Choctawhatchee drainage, FL; Mississippi River tributaries of southern AR and more north in TN to Obion drainage. Allopatric to grayfin redhorse, an Apalachicola drainage endemic, AL, GA, and FL. Inhabits medium to large size, sandy to rocky streams and rivers, occasionally impoundments. Often common.

ADULT SIZE: 156-353 mm SL, to 508 mm TL maximum.

BIOLOGY: Aspects of sensory structure described by Miller and Evans (1965. Copeia: 467-87). Movements and home range studied by Gunning (1963. in *Animal Orientation*) and Gunning and Shoop (1964. Prog. Fish-Cult.:76-79), who stated it spawns late April-May in LA. Food, growth, maturation, and fecundity probably similar to that of grayfin redhorse, studied by McSwain et al. (1973. Final Rep. Fish. Investig. F-21-5, Study 12, Job 5, Ga. Dept. Nat. Resour.).

Compiler: R. E. Jenkins. February 1980.

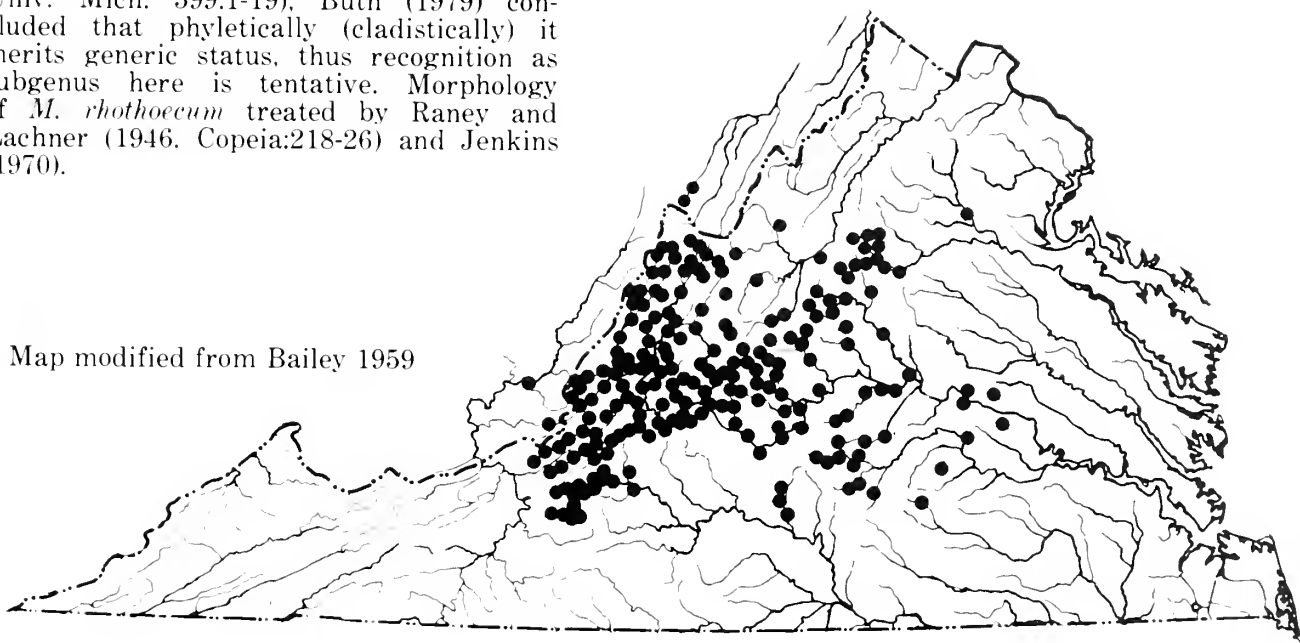
Moxostoma rathbuni (Thoburn)
Torrent sucker

Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Described by Thoburn (in Jordan and Evermann 1896. Bull. U.S. Natl. Mus. 47:1-1240) from uncertain and at least partly erroneous locality which remains unidentified (in part Hubbs 1930. Misc. Publ. Mus. Zool. Univ. Mich. 20:1-47).
SYSTEMATICS: Subgenus *Thoburnia*. Placed with *M. hamiltoni* in *rathbuni* species-group; *M. atripinne* is third member of subgenus. Morphology and color of group suggest *Thoburnia* closely related to genus *Hypentelium* (Jenkins 1970. Ph.D. diss., Cornell Univ.), a view supported by genetic studies of Buth (1979. Comp. Biochem. Physiol. 63B:7-12). Although *Thoburnia* reduced to subgenus by Bailey (1959. Occas. Pap. Mus. Zool. Univ. Mich. 599:1-19), Buth (1979) concluded that phylogenetically (cladistically) it merits generic status, thus recognition as subgenus here is tentative. Morphology of *M. rathbuni* treated by Raney and Lachner (1946. Copeia:218-26) and Jenkins (1970).



WV: Pendleton Co., Potomac River drainage 113 mm SL (NCSM).



Map modified from Bailey 1959

DISTRIBUTION AND HABITAT: North-central VA and adjacent eastern WV. Generally distributed in James drainage from mountains to Fall Line. Limited in Potomac drainage to scattered populations, some known since 1885, in upper South Fork Shenandoah system; in upper North Fork system of South Branch Potomac, where known since 1973 and possibly introduced. Upper Rappahannock drainage population known since 1958, probably introduced. Upper Roanoke system of Roanoke drainage *Thoburnia* population, known since 1867, previously thought to be *M. hamiltoni* but identified as *M. rathbuni* by Jenkins (1970) and Buth (1977. Biochem. Syst. Ecol. 5:57-60). Two other Roanoke populations, including one in Chowan system, discovered after 1967. Apparently absent today from New (upper Kanawha) drainage; at least two of supposed four records apparently not from

New (in part Hubbs 1930); one (dated 1885) of other two records of uncertain exact locality (not plotted). Generally common in small to medium-sized streams, cold to warm, of high to moderate gradient, and usually clear. Juveniles and adults in riffles and runs of gravel to boulder and bedrock; young in runs and pools.

ADULT SIZE: 80-160 mm SL.

BIOLOGY: Aspects of sensory morphology treated by Miller and Evans (1965. Copeia: 467-87). Feeds partly on plants (Flemer and Woolcott 1966. Chesapeake Sci. 7:75-89) and chironomid larvae (Jenkins 1970). Maximum life span seven years (Raney and Lachner 1946. Am. Midl. Nat. 36:675-81). Spawns in April and May, based on gonadal development and nuptial color and tubercles.

Compiler: R. E. Jenkins. July 1979.

Moxostoma robustum (Cope)
Smallfin redhorse

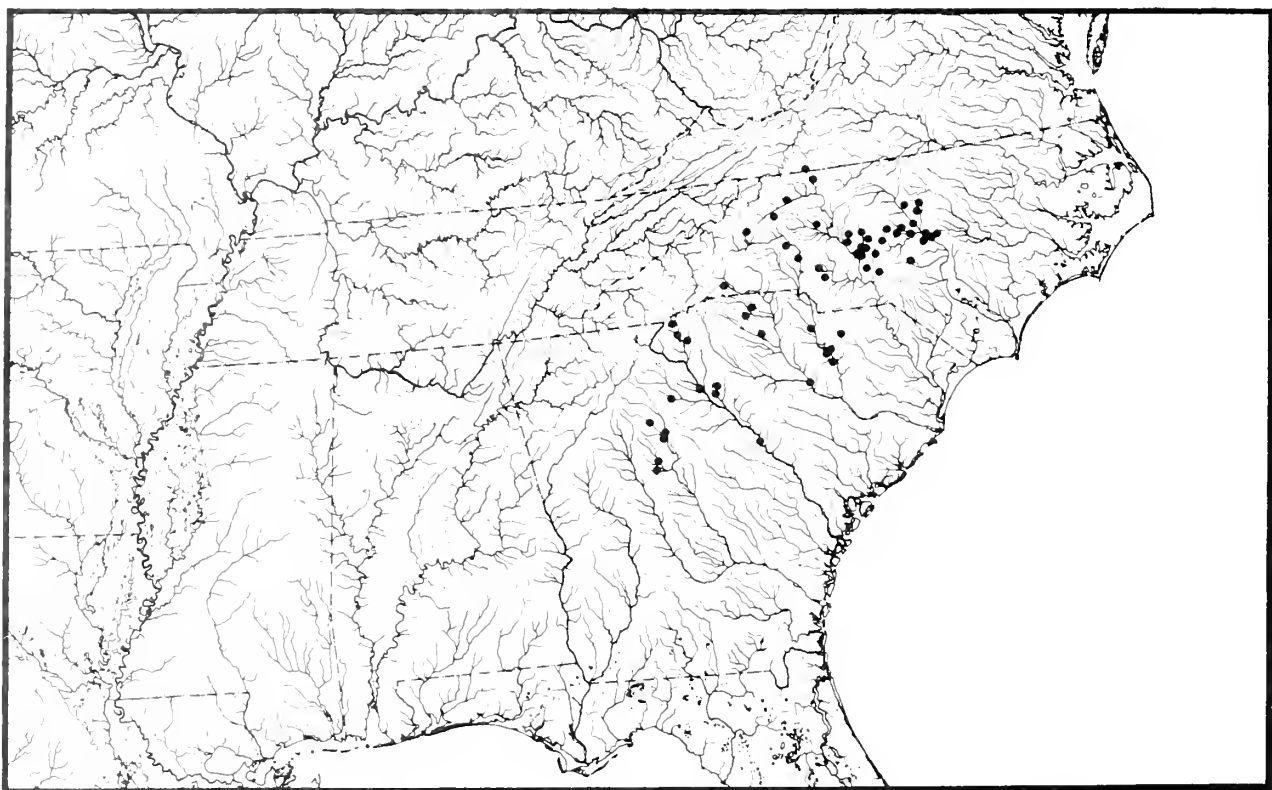
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Yadkin River, NC
(Cope 1870. Proc. Am. Philos. Soc. 11:448-95).

SYSTEMATICS: Subgenus *Scartomyzon*.
Forms *M. robustum* species-group with *M. congestum* and *M. austrinum* (Robins and Raney 1957. Tulane Stud. Zool. 5:291-318; Jenkins 1970. Ph.D. diss., Cornell Univ.); *M. rupiscartes* added to group by Buth (1979. Ph.D. diss., Univ. Illinois). Morphology described by Robins and Raney (1956. Cornell Univ. Agric. Exp. Sta. Mem. 343:1-56) and Jenkins (1970).



NC: Randolph Co., Uwharrie River, 79 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Five major drainages from Cape Fear drainage south to Oconee system of Altamaha drainage, VA to GA; essentially a Piedmont form. Occupies medium to large streams and rivers that are warm and with substrates rocky to appreciably silted; may tend to avoid latter condition. Based on few observations, inhabits pools and slow runs. Also occurs in large impoundments. Appears generally uncommon.

ADULT SIZE: 215-360 mm SL. At least once reached 2.7 kg (Cope 1870).

BIOLOGY: Aspects of sensory morphology noted by Miller and Evans (1965. Copeia: 467-87). Specimens in apparent spawning condition in spring.

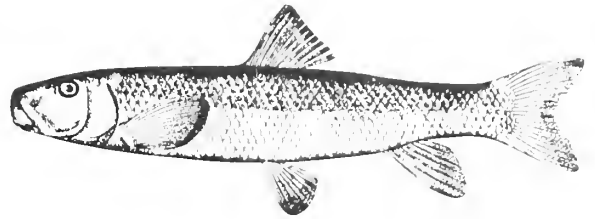
Compiler: R. E. Jenkins. January 1980.

Moxostoma rupiscartes Jordan and
Jenkins
Striped jumprock

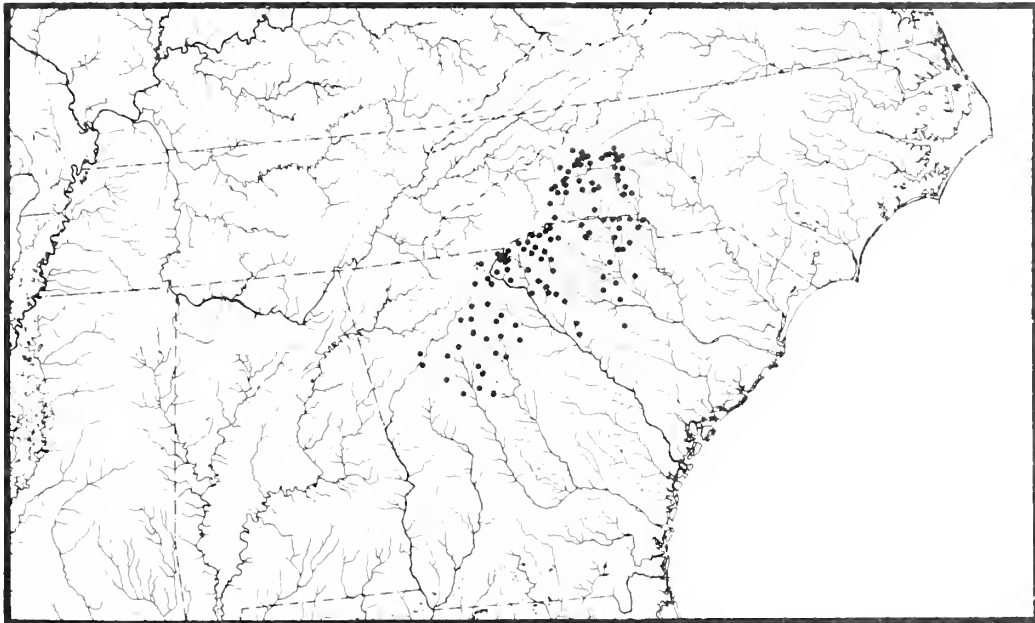
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Catawba River at ca. 1.6 km below mouth of Buck's Creek, near Marion, McDowell Co., NC (Jordan and Jenkins in Jordan 1889. Proc. U.S. Natl. Mus. [1888] 11:351-62; locality descriptors *vide* Jordan 1889. Bull. U.S. Fish Comm. 8:97-173). Locality fixed by lectotype designation of Robins and Raney (1956. Cornell Univ. Agric. Exp. Sta. Mem. 343:1-56).

SYSTEMATICS: Subgenus *Scartomyzon*. Regarded most closely related to *M. lachneri* and *M. cervinum* by Robins and Raney (1956) and Jenkins (1970. Ph.D. diss., Cornell Univ.), but genetic study by Buth (1978. Ph.D. diss., Univ. Illinois) placed it closer to *M. robustum*. Shows considerable structural and color variation, particularly separating Santee and Savannah populations from those of Altamaha and Apalachicola (Robins and Raney 1956). Buth (1979) found species level biochemical differences between these groups.



NC: Catawba River (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Widespread in Blue Ridge and Piedmont of four major drainages from Santee drainage to upper Chattahoochee system of Apalachicola drainage, NC to GA. Recently discovered in extreme upper Edisto drainage, SC, and Third Creek of Pee Dee drainage, NC. Range in Edisto probably limited by unsuitable habitat below Fall Line; possibly introduced to Pee Dee. Typically in warm streams of small to medium size; occupies runs and riffles with rubble, gravel and sand bottom. Often common. Largest specimen taken in only known Pee Dee drainage collection.

ADULT SIZE: 130-250 mm SL.

BIOLOGY: Aspects of sensory morphology considered by Miller and Evans (1965. Copeia:467-87). Ripe during late March in NC (Robins and Raney 1956).

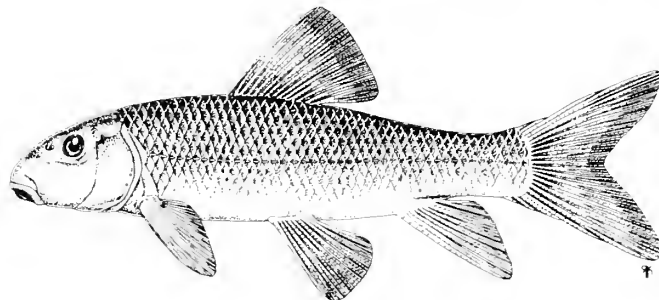
Compiler: R. E. Jenkins. January 1980.

Moxostoma valenciennesi Jordan
Greater redhorse

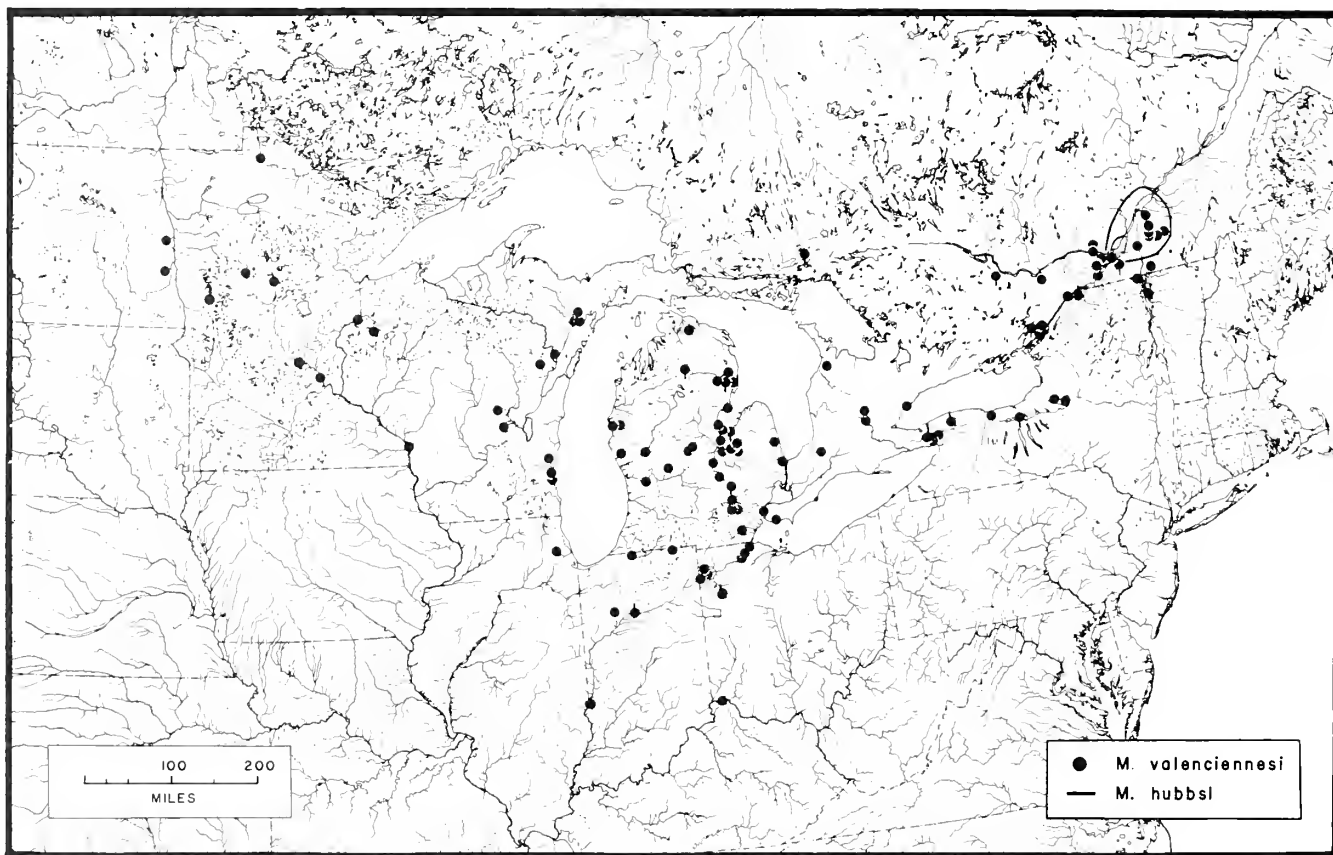
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Lake Ontario (Valenciennes 1844. *Histoire Naturelle des Poissons* 17, as *Catostomus carpio*; nomenclatural review by Jenkins 1970. Ph.D. diss., Cornell Univ.).

SYSTEMATICS: Subgenus *Megapharynx*, with *M. hubbsi*. Systematics reviewed by Jenkins (1970). Electrophoretic study by Buth (1978. Ph.D. diss., Univ. Illinois; 1979. *Comp. Biochem. Physiol.* 63B:7-12).



(NCSM)



DISTRIBUTION AND HABITAT: St. Lawrence drainage, QU, west through Great Lakes basin to WI (excluding Lake Superior); only pre-1900 records from Red River of North drainage in ND and Lake of the Woods; upper Mississippi basin, MN, WI, and, in 1901, IL; Ohio basin of IN and OH, where all but one IN record is old. Typically occupies large streams, big rivers, and lakes; occasionally in moderate size streams. Probably prefers relatively unsilted substrates. Generally uncommon or rare.

ADULT SIZE: ca. 400-650 mm SL.

BIOLOGY: Aspects of sensory morphology treated by Miller and Evans (1965. *Copeia*: 467-87). Food of one juvenile was chironomid larvae, microcrustaceans, molluscs, and plant material (Rimsky-Korsakoff 1930. *Suppl. 19th Annu. Rep.*, [1929] N.Y. St. Cons. Dept.). Size data summarized by Scott and Crossman (1973. *Freshwater Fishes of Canada*). Spawns late June-early July at 16-19°C in gravel runs of St. Lawrence River in Thousand Islands region (Jenkins and Jenkins in press. *Can. Field-Nat.*).

Compiler: R. E. Jenkins. February 1980.

***Xyrauchen texanus* (Abbott)**
Humpback sucker

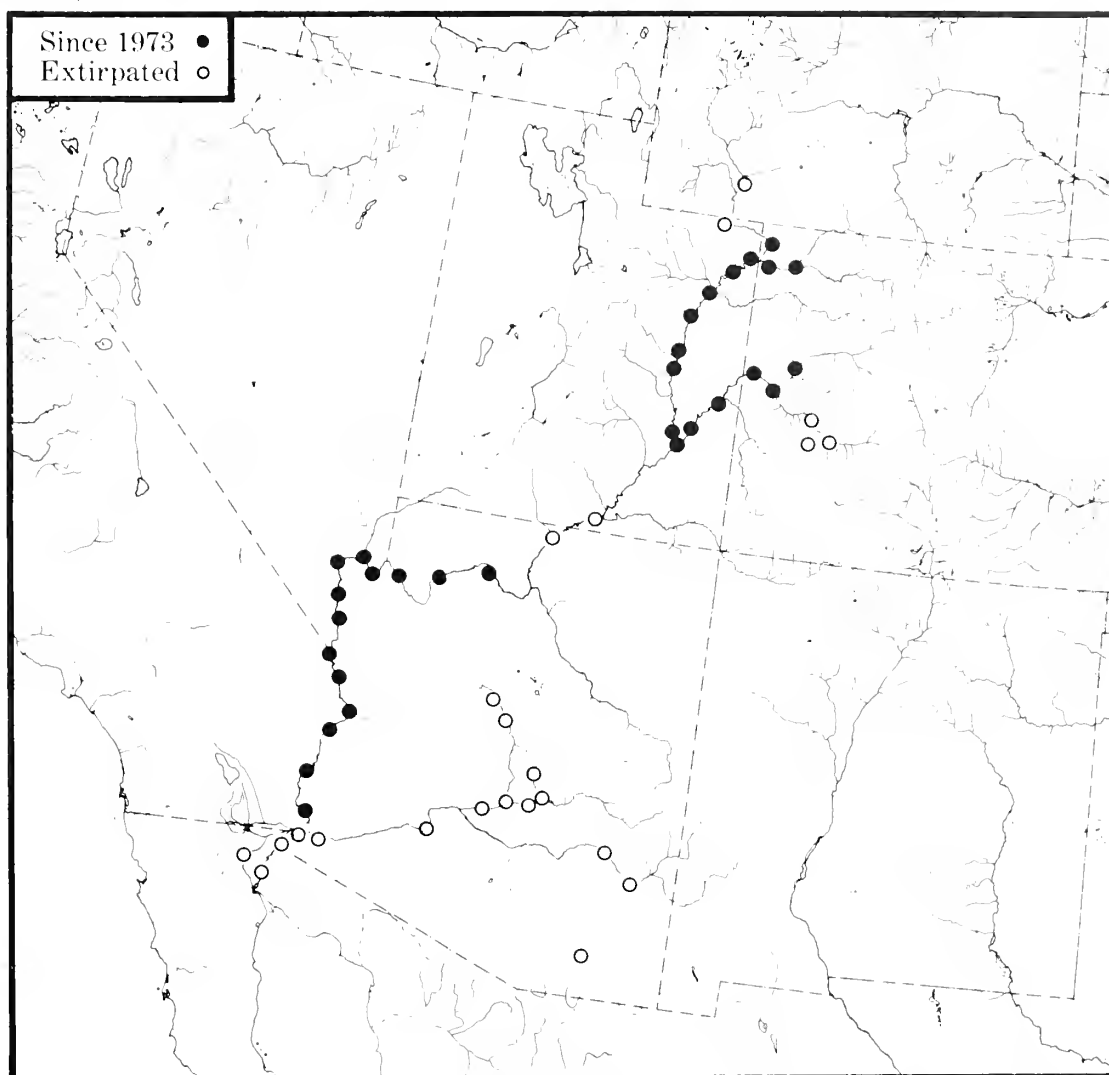
Order Cypriniformes
Family Catostomidae

TYPE LOCALITY: Colorado and New rivers, AZ (Abbott 1861. Proc. Acad. Nat. Sci. Phila. [1860] 12:473-74).

SYSTEMATICS: Monotypic genus, apparently most closely related to *Chasmites* and *Catostomus* (Nelson 1948. J. Morphol. 83:225-51; Miller 1958. in *Zoogeography* Am. Assoc. Adv. Sci. Publ. 51:187-222). Hybridizes with *Catostomus latipinnis* and *C. insignis* (Hubbs and Miller 1953. Pap. Mich. Acad. Sci. Arts Lett. 38:207-33).



WY: Green River, 36 cm SL
(Moyle 1976).



DISTRIBUTION AND HABITAT: Large rivers of Colorado River basin. Generally in slow areas, backwaters and eddies. Presently occurs only above Grand Canyon and in lakes Mead, Mohave, and Havasu on lower Colorado River. Very rare.

ADULT SIZE: 400-600 mm TL.

BIOLOGY: Little published. Minckley (1973. *Fishes of Arizona*) summarized known information. Although individuals have been observed spawning, reproduction in reservoirs seems to be unsuccessful (Minckley 1978. Abstr. 58th Ann. ASIH). Recent young found in Green River of UT (Holden 1977. PR-13-1 Bio/West).

Compiler: P. B. Holden. September 1978.

Misgurnus anguillicaudatus (Cantor)
Oriental weatherfish

Order Cypriniformes
Family Cobitidae

TYPE LOCALITY: Chusan, China (Cantor 1842. *Ann. Mag. Nat. Hist.* 9:481-93).

SYSTEMATICS: Illustrations, descriptions, and discussion of systematics in Nichols (1943. *The Fresh-water Fishes of China*) and Berg (1949. *Freshwater Fishes of the U.S.S.R. and Adjacent Countries*, Vol. II). Included in keys to fishes of United States by Moore (in Blair et al. 1968. *Vertebrates of the United States*) and CA by Moyle (1976. *Inland Fishes of California*).



Formosa : Market at Hua Lien, east of Taiwan. 84 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Native distribution — Eastern Asia. Established in headwaters of the Shiawassee River, MI, and several flood control canals in Orange Co., CA. Common at United States localities. Found in still or slow-flowing waters with muddy bottoms. Burrows in bottom. Able to live in deoxygenated water due to intestinal accessory respiratory organ. Introductions due to escapes from aquarium supply companies in the 1930's.

ADULT SIZE: 100-200 mm TL, 220 mm SL maximum.

BIOLOGY: Omnivorous. Eggs are reddish and adhesive. Sexual dimorphism in size and pectoral and dorsal fins. Summary of literature on reproduction by Breder and Rosen (1966. *Modes of Reproduction in Fishes*).

Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Ictalurus brunneus (Jordan)
Snail bullhead

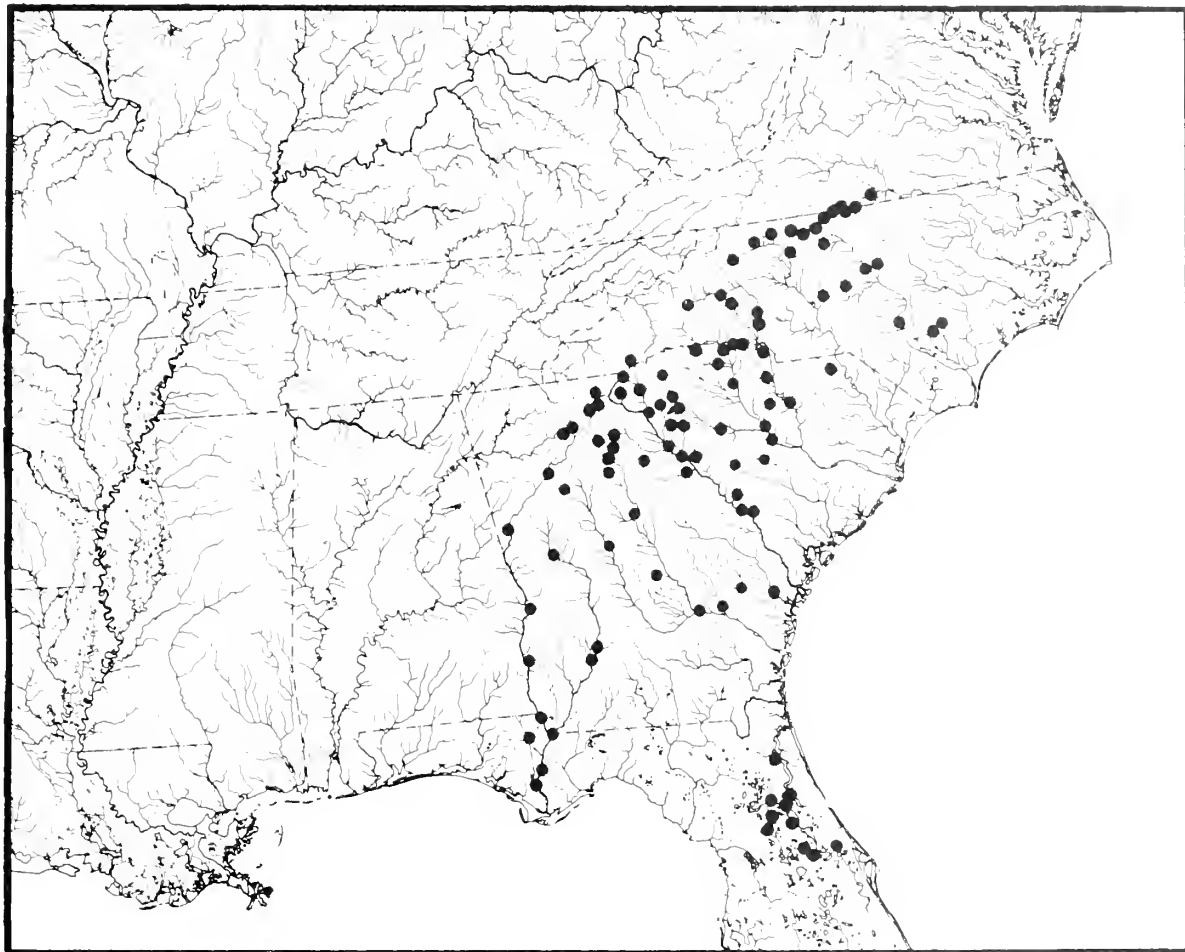
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: South Fork of Ocmulgee River, at Flat Rock, Dekalb Co., GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. 11: 307-77).

SYSTEMATICS: Yerger and Relyea (1968. Copeia: 361-84) reviewed systematics; showed *I. brunneus* specifically distinct from *I. platycephalus*, with which it was previously synonymized.



SC: Barnwell Co., Savannah River system, young, 103 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Dan River system (Roanoke River drainage), NC and VA, south to Altamaha River drainage, GA, and Apalachicola River system in GA, AL, and FL. Recently reported from extreme headwaters of Coosa River system, GA, which it apparently reached by stream capture (Bryant et al. 1979. Southeastern Fishes Council Proc. 2: 1-4). Disjunct population in middle St. Johns River system, FL (Burgess et al. 1977. Fla. Scientist 40: 33-41); origin discussed and clarified by Burgess and Franz (1978. Am. Midl. Nat. 100: 160-70). Typically in streams having hard, rocky bottom and moderate to swift cur-

rent, where it is found in holes, flowing pools, and often in riffles.

ADULT SIZE: 243 mm SL.

BIOLOGY: Gilbert (*in* Gilbert [ed.] 1978. *Rare and Endangered Biota of Florida* 4: 33-35) summarized known biological data. Omnivorous, but subsists principally on aquatic molluscs; other food items include aquatic insect larvae, small fishes, and filamentous algae. In St. Johns River, females with mature ova found from February to July.

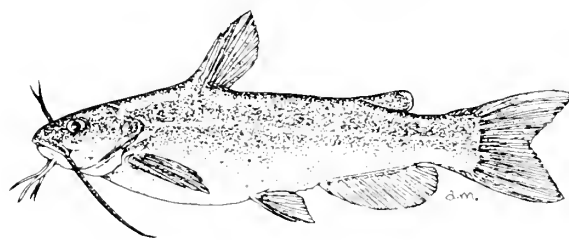
Compilers: C. R. Gilbert and G. H. Burgess. May 1979.

Ictalurus catus (Linnaeus)
White catfish

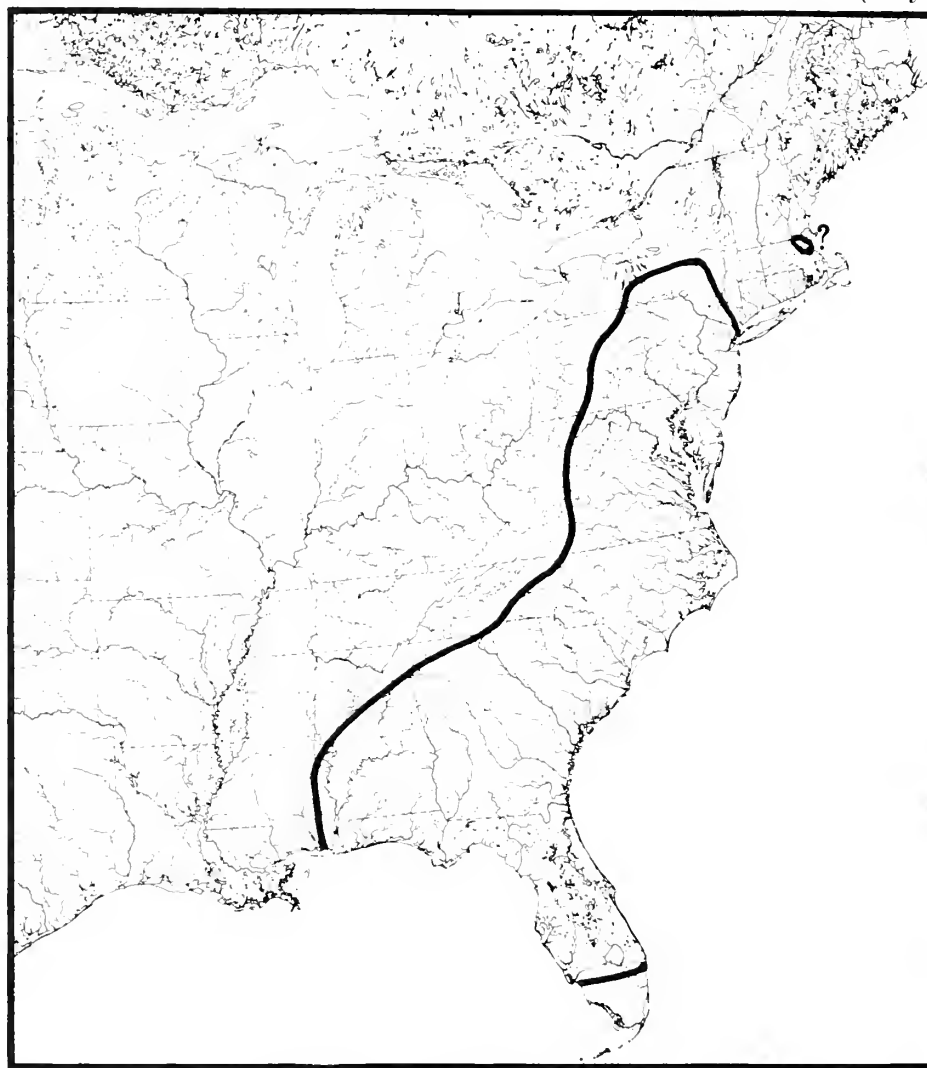
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: "Northern part of America" (Linnaeus 1758. *Systema naturae* Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: No definitive study; no subspecies recognized. Phylogenetic relationships to other ictalurids presented by Taylor (1969. U.S. Natl. Mus. Bull. 282:1-315).



CA: Lake Co., Clear Lake, 11 cm SL (Moyle 1976).



Line encloses native distribution

DISTRIBUTION AND HABITAT: Native to the Atlantic coastal states from FL to NY; widely introduced outside native range. Characteristic of rivers and ponds. Common.

BIOLOGY: Breder and Rosen (1966. *Modes of Reproduction in Fishes*) and Smith (1979. *The Fishes of Illinois*) described spawning. Miller (in Calhoun 1966. *Inland Fisheries Management*; Calif. Fish Game:403-34) summarized ecology.

ADULT SIZE: 592 mm TL maximum.

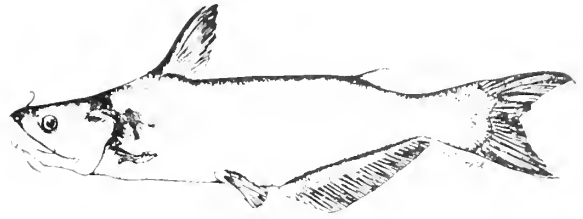
Compiler: G. S. Glodek. August 1979.

Ictalurus furcatus (Lesueur)
Blue catfish

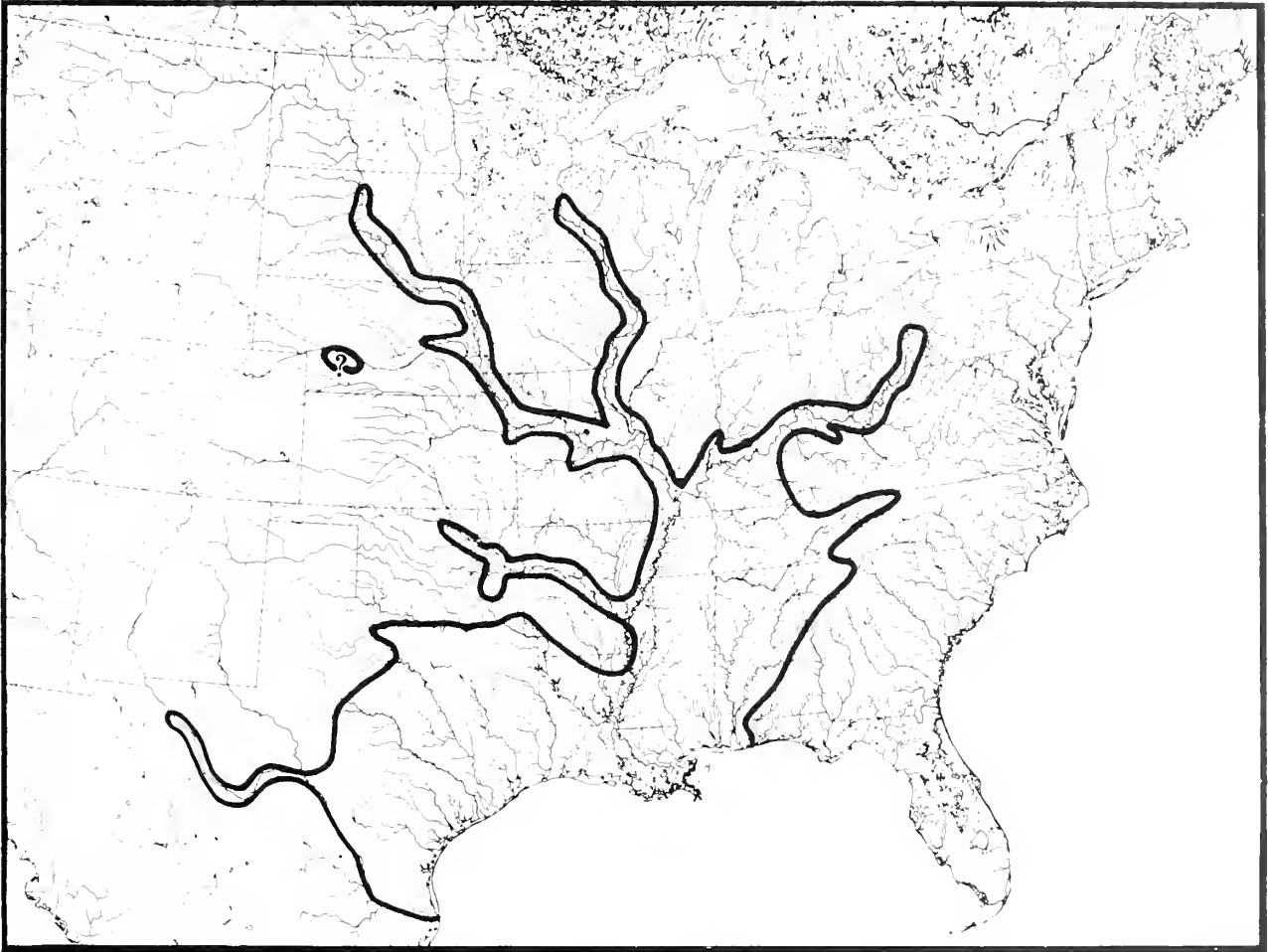
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: New Orleans (Lesueur in Valenciennes 1840. *Histoire Naturelle des Poissons* 15).

SYSTEMATICS: No definitive study. A related fossil ictalurid, *I. lambda*, known from Pliocene deposits of KS (Hubbs and Hibbard 1951. *Copeia*:8-14). Phylogenetic relationships to other ictalurids presented by Taylor (1969. U.S. Natl. Mus. Bull. 282:1-315).



CA: Imperial Co., Fish Breeders Inc. fish farm, juvenile, 17 cm SL (Moyle 1976).



Line encloses native distribution

DISTRIBUTION AND HABITAT: Native to major rivers of Mississippi, Missouri, and Ohio basins of central and southern United States, south into Mexico and northern Guatemala. Characteristic of deep areas of large rivers throughout range and considered an inhabitant of swift chutes and pools with swift currents (Pflieger 1975. *The Fishes of Missouri*). Introduced to Rappahannock and James drainages, VA.

ADULT SIZE: 1194 mm TL maximum.

BIOLOGY: Smith (1979. *The Fishes of Illinois*) commented on reproduction. Brown and Dendy (1962. *Proc. Southeast. Assoc. Game Fish Comm.* [1961] 15:219-22) discussed feeding habits. Conder and Hoffarth (1965. *Proc. Southeast. Assoc. Game Fish Comm.* [1961] 15:348-54) discussed age and growth. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) listed length-weight relationships, age-length relationships, and foods.

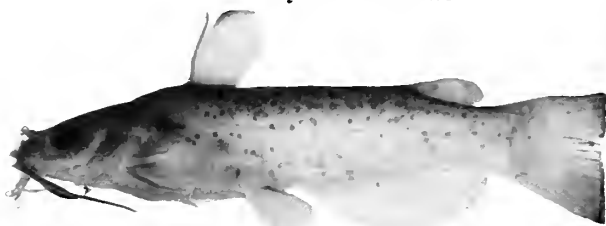
Compiler: G. S. Glodek, August 1979.

Ictalurus lupus (Girard)
Headwater catfish

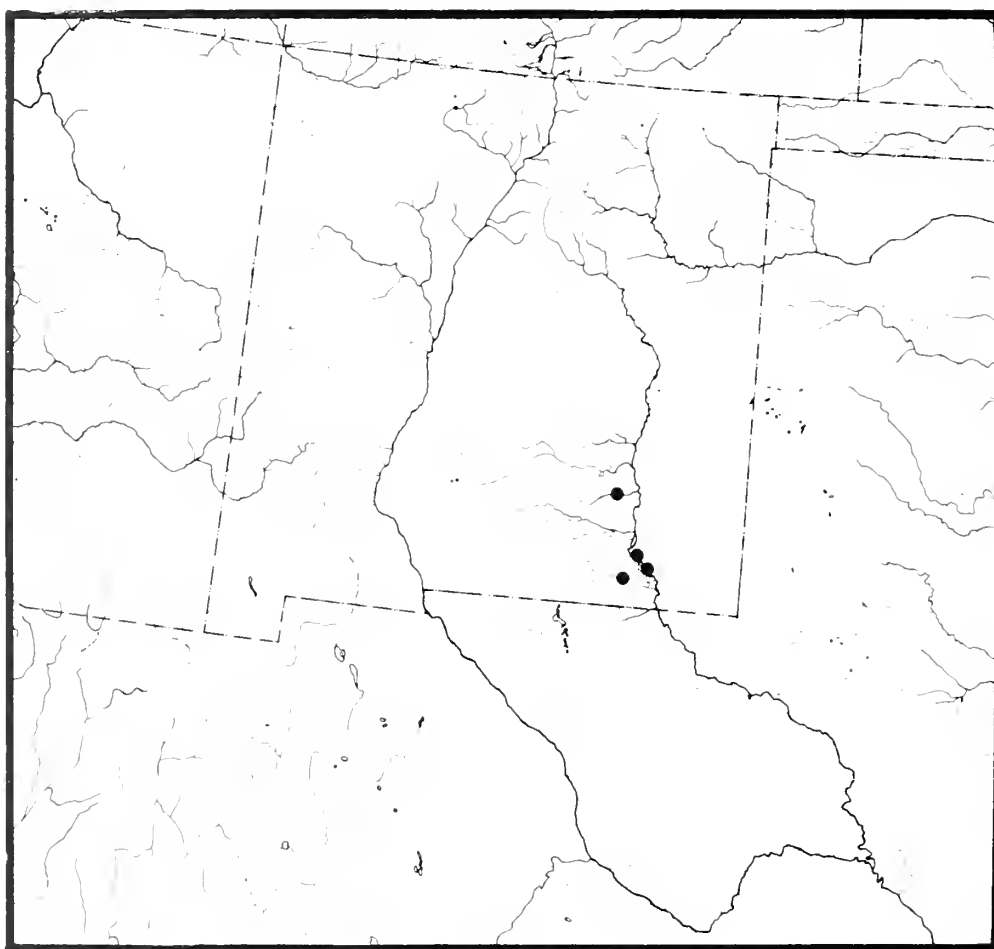
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Rio Pecos, TX (Girard 1858. *Fishes. in U.S. Pacific Railroad Surv.* 10: 1-400).

SYSTEMATICS: No definitive study. Koster (1957. *Guide to the Fishes of New Mexico*) and Moore (in Blair et al. 1968. *Vertebrates of the United States*) listed distinguishing characters. In *Ictalurus punctatus* species group, and said by Moore (1968) to be most closely related to *I. pricei* of Rio Yaqui drainage, Mexico and AZ. Among least known and studied of North American freshwater fishes.



Mexico: Nuevo Leon, Rio Salado
Pose Santeo, 108 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Conner (1977. Ph.D. diss., Tulane Univ.) showed range as from Rio Grande to Colorado River drainages (apparently extirpated from latter), although Koster (1957) indicated occurrence in NM restricted to lower parts of Pecos River system of Rio Grande drainage. Moore (1968) listed it from NM, TX, and Mexico. Supposedly ecologically restricted to headwater situations, but Koster's

records from NM (assuming proper identification) are from main Pecos River or lower parts of tributaries.

ADULT SIZE: Unknown. Apparently much smaller maximum size than related *I. punctatus*.

BIOLOGY: Not studied.

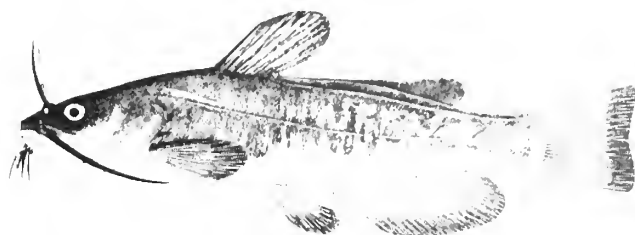
Compilers: C. R. Gilbert and G. H. Burgess.
December 1979.

Ictalurus melas (Rafinesque)
Black bullhead

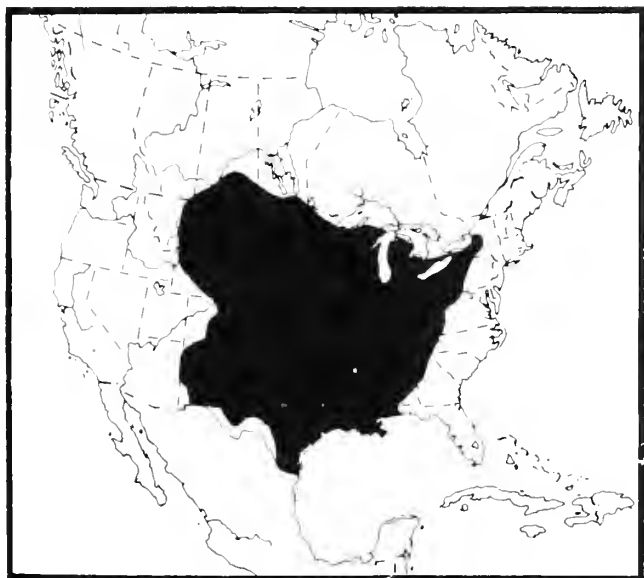
TYPE LOCALITY: "Ohio River" (Rafinesque 1820. Q. J. Sci. Lit. Arts 9:48-55).

SYSTEMATICS: Two subspecies sometimes recognized: *I. melas catulus* from Gulf coast states and northern Mexico, and *I. m. melas* from farther north (Smith 1979. *The Fishes of Illinois*; Scott and Crossman 1973. *Freshwater Fishes of Canada*). List of synonyms provided by Scott and Crossman (1973). Phylogenetic relationships with other ictalurids presented by Taylor (1969. U.S. Natl. Mus. Bull. 282:1-315), and Lundberg (1975. Univ. Mich. Mus. Zool. Pap. Paleo. 11).

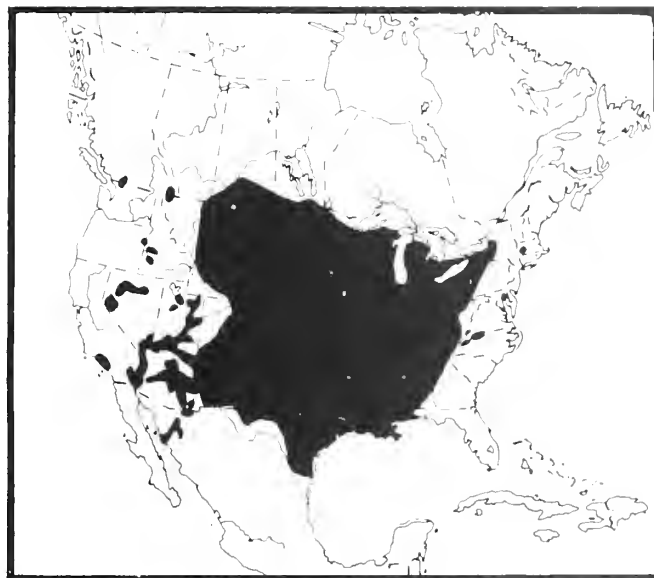
Order Siluriformes
Family Ictaluridae



MD: Anne Arundel Co.,
Annapolis Reservoir, 99 mm
SL (NCSM).



Former Distribution



Present Distribution

DISTRIBUTION AND HABITAT: Southern ON, Great Lakes and St. Lawrence River, south to Gulf of Mexico and northern Mexico, and from MT to Appalachians. Introduced outside native range. Characteristic of ponds, pools of all sizes in streams and rivers, and in swampy habitats throughout range. Common.

ADULT SIZE: ca. 380 mm TL.

BIOLOGY: Breder and Rosen (1966. *Modes of Reproduction in Fishes*) discussed reproduction. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) summarized fisheries information, age-length relationships, and diet. Temperature tolerances, relationships between age classes, some aspects of diet, and parasites briefly discussed by Scott and Crossman (1973). Herrick (1905. J. Comp. Neurol. Psychol. 15:379-81) described central gustatory pathways in brain and general form, function, and innervation of taste buds.

Compiler: G. S. Glodek, August 1979.

Ictalurus natalis (Lesueur)
Yellow bullhead

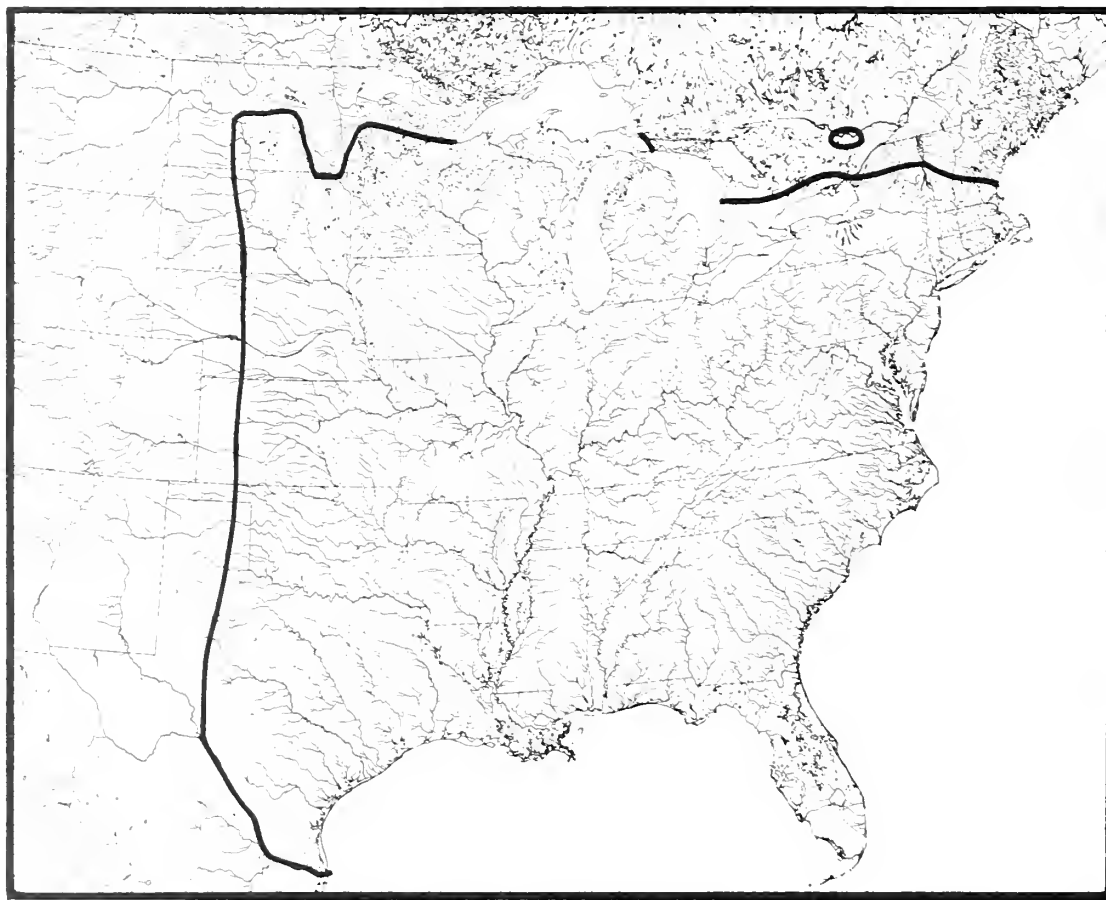
Order Siluriformes
Family Ictaluridae



FL: Alachua Co., Gumroot
Creek, 64 mm SL (NCSM).

TYPE LOCALITY: "North America" (no locality mentioned) (Lesueur 1819. Mem. Mus. d'Hist. Nat. Paris 5:148-61).

SYSTEMATICS: No definitive systematic study of species. Two subspecies recognized at one time but synonymized by Bailey et al. (1954. Proc. Acad. Nat. Sci. Phila. 106: 109-64). Scott and Crossman (1973. *Freshwater Fishes of Canada*) commented that *I. n. crebennus* and *I. n. natalis* still often considered distinct subspecies and provided list of synonyms.



Line encloses native distribution

DISTRIBUTION AND HABITAT: Originally throughout eastern and central United States; also introduced outside native range. Common in areas of heavy vegetation in shallow, clear bays of lakes, ponds, and slow moving streams (Scott and Crossman 1973). Tends to inhabit smaller, weedier bodies of water than *I. nebulosus* in southern part of range. Common.

ADULT SIZE: ca. 380 mm TL.

BIOLOGY: Breder and Rosen (1966. *Modes of Reproduction in Fishes*) discussed reproduction. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) sum-

marized fishery information, diet, and age class-length relationships. Scott and Crossman (1973) discussed parasites and predators. Yerger (1953. *Copeia*:115) reported a snake predator. Taste system structure and function described by Atema (1971. *Brain Behav. Evol.* 4:273-94). Orientation and taste discussed by Bardach et al. (1967. *Science* 155:1276-78). Chemical recognition, agnostic behavior, and establishment of social hierarchies discussed by Todd (1971. *Sci. Am.* 224[5]:98-108). Effects of detergents on taste buds reported by Bardach et al. (1965. *Science* 148:1605-07).

Compiler: G. S. Glodek, August 1979.

Ictalurus nebulosus (Lesueur)
Brown bullhead

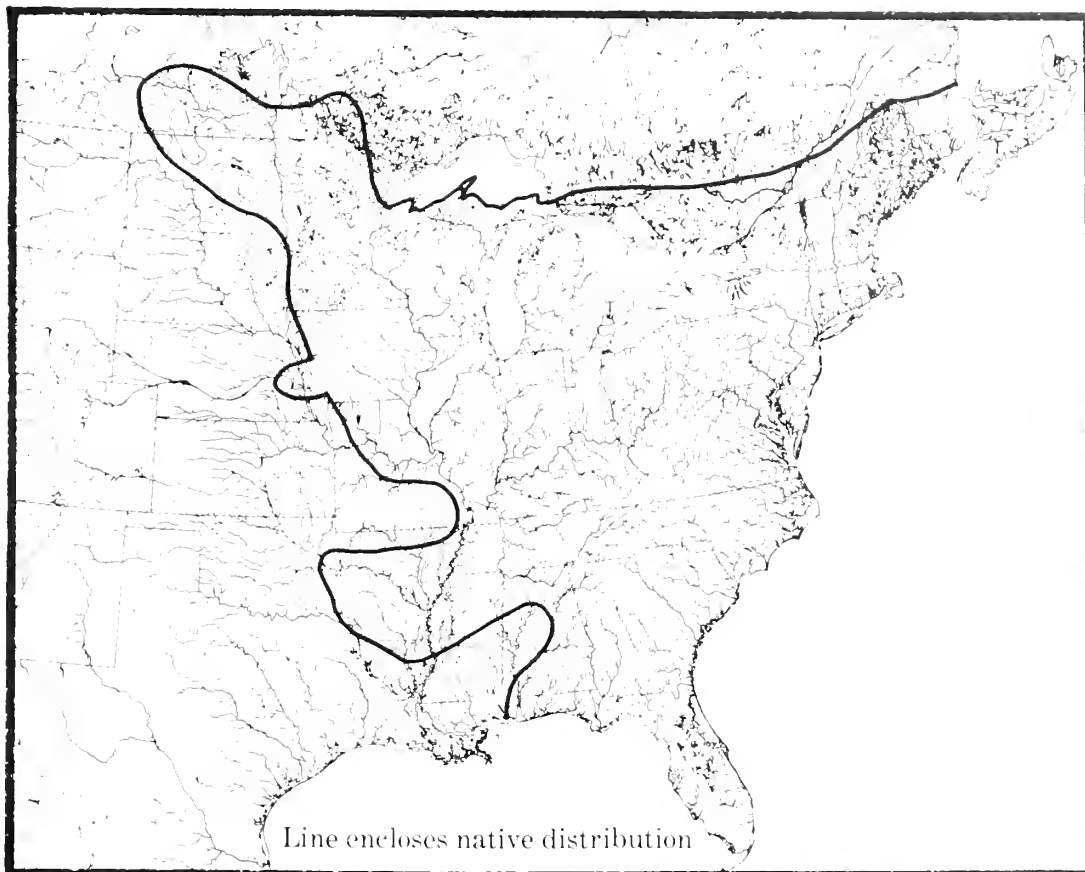
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Delaware River at Philadelphia, PA (Lesueur 1819. Mem. Mus. d'Hist. Nat. Paris 5:148-61).

SYSTEMATICS: Confused and in need of revision. Subspecific names not always used, but two subspecies often recognized: northern *I. nebulosus nebulosus* and southern *I. n. marmoratus*, differing greatly in color patterns. Synonymies given by Scott and Crossman (1973. *Freshwater Fishes of Canada*). Smith (1979. *The Fishes of Illinois*) commented briefly on geographic variation. Phylogenetic relationships discussed by Taylor (1969. U. S. Natl. Mus. Bull. 282:1-315).



MD: Garrett Co., Wolf Swamp.
101 mm SL (NCSM).



Line encloses native distribution

DISTRIBUTION AND HABITAT: Originally throughout eastern half of the United States and into southern Canada; widely introduced outside native range. Commonly in moderately clear water with ample vegetation. Tends to occur in larger and deeper waters than other bullheads (Trautman 1957. *The Fishes of Ohio*).

ADULT SIZE: 70-380 mm TL. 532 mm TL maximum.

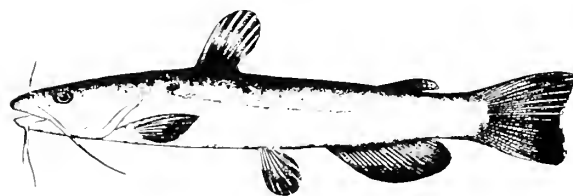
BIOLOGY: Forbes and Richardson (1908. *The Fishes of Illinois*) described feeding and reproduction. Breder and Rosen (1966.

Modes of Reproduction in Fishes) and Scott and Crossman (1973) summarized reproductive habits. Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) commented on reproduction, diet, and hybridization with *I. melas*. Oxygen, temperature, and salinity tolerances; feeding habits; parasites; and predators discussed by Scott and Crossman (1973). Bardach et al. (1967. Science 155:1276-78) discussed orientation and taste. Chemical recognition, agnostic behavior, and establishment of social hierarchies presented by Todd (1971. Sci. Am. 224:98-106).

Compiler: G. S. Glodek, August 1979.

Ictalurus platycephalus (Girard)
Flat bullhead

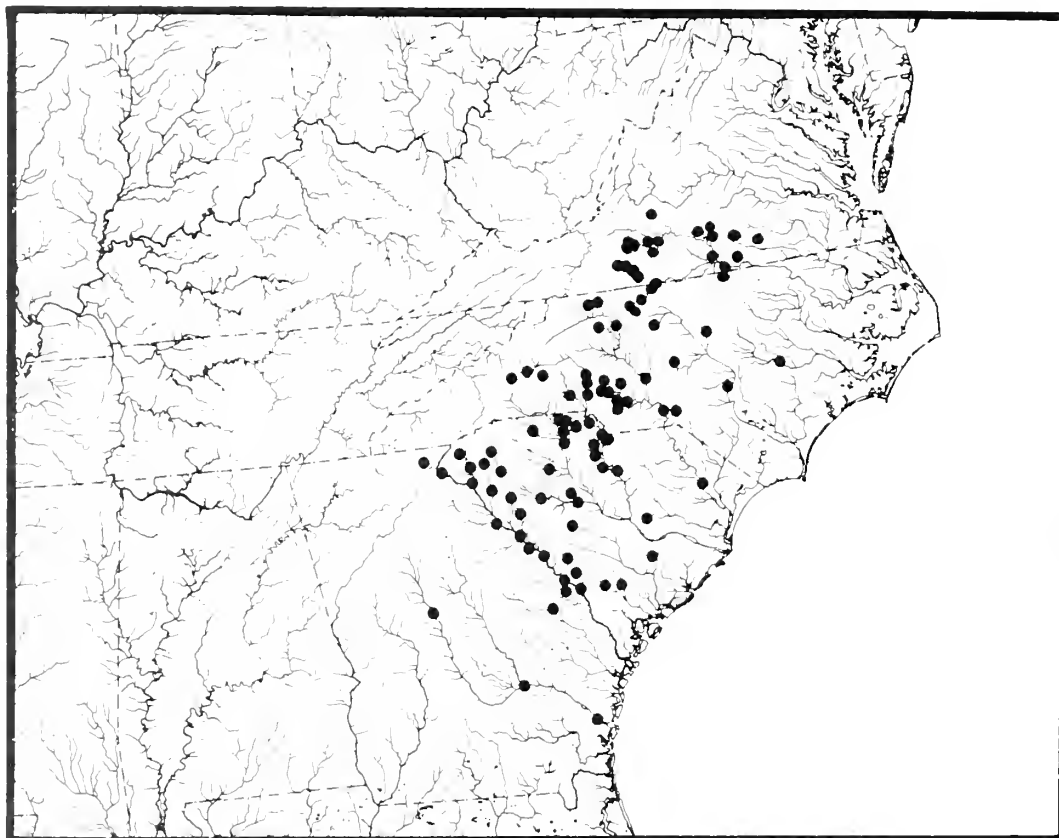
Order Siluriformes
Family Ictaluridae



TYPE LOCALITY: Near Anderson, SC (presumably Savannah River drainage) (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:157-61).

SYSTEMATICS: Species reviewed by Yerger and Relyea (1968. Copeia: 361-84), who distinguished it from *I. brunneus* and *I. serracanthus*, all previously considered conspecific.

SC: Anderson (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Piedmont and Coastal Plain of Atlantic slope, from Roanoke River drainage, VA and NC, south to Altamaha River drainage, GA. No record from intervening Tar drainage, NC. Adults occur mostly in slow-water areas of large rivers with soft mud, muck, or sand bottom, which is often covered with organic detritus. Young individuals tend to inhabit smaller, clearer streams. In VA adults are found relatively frequently in small to medium-sized gravelly and rocky streams. Not rare.

BIOLOGY: Olmsted and Cloutman (1979. Trans. Am. Fish. Soc. 108:38-42) studied life history in NC. Oldest calculated age of males seven years, of females five years. Food habits varied with season, maturity, and sex. Adults commonly consumed bryozoans (*Pectinatella*) throughout year, annelids during spring (probably after surface runoffs), and molluscs (primarily *Corbicula*) during summer and fall. Insects were important food items in both mature and immature individuals at all seasons, and fishes the most important items in diet of adults. Spawning occurred mostly during June and July, and females attained sexual maturity during third year.

Compilers: C. R. Gilbert and G. H. Burgess. May 1979.

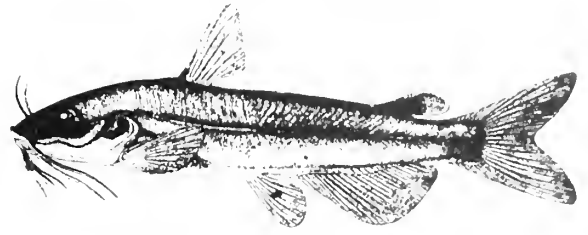
ADULT SIZE: 179-286 mm TL.

Ictalurus pricei (Rutter)
Yaqui catfish

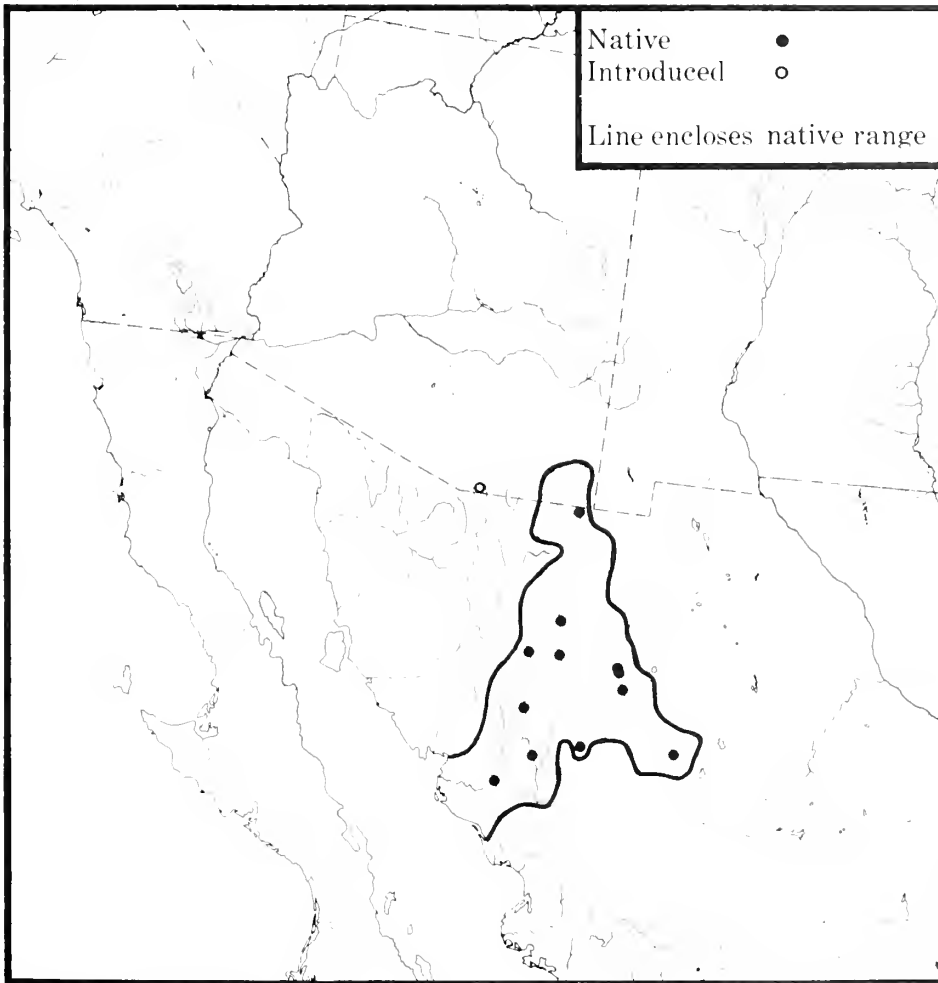
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: San Bernardino Creek, just south of international border (in extreme southeastern AZ), Sonora, Mexico (Rutter 1896. Proc. Calif. Acad. Sci. 6: 245-67).

SYSTEMATICS: Relationships obscure, similar to *I. lupus* of TX and eastern Mexico, and other, apparently undescribed species (Miller 1978. in Trans. Symp. Biol. Res. Chihuahuan Desert Region: 365-81). Systematics of genus *Ictalurus* and Mexican species in particular poorly understood. *Ictalurus meeki* from Rio Yaqui may be a synonym (Miller 1978).



Mexico: Sonora, Arroyo Cuchuaqui, 147 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Moderate to large streams from Delta to highlands (2,100 m elevation) in Rio Yaqui drainage, Mexico, and (formerly) probably in extreme southeast AZ. Introduced in 1899 into Santa Cruz River system (in reservoir fed by Monkey Spring) where it persisted until the 1950's. Now extirpated from United States waters (Minckley 1973, *Fishes of Arizona*). Most common in larger rivers in areas of medium to slow currents over sand/rock bottom (Hendrickson et al. 1979. Rept. U.S. Fish Wildl. Serv., Albuquerque, NM).

ADULT SIZE: to 500 mm SL.

BIOLOGY: Little known. Males taken from Rio Yaqui basin with swollen heads in breeding condition and females with ripe ova. Foods of four individuals, other fishes and detritus (Minckley original data).

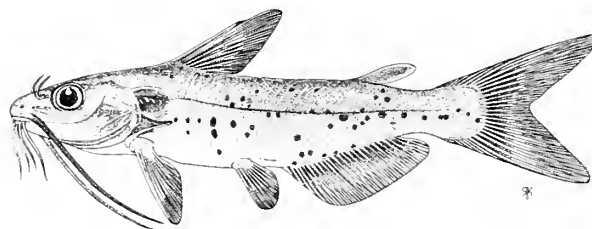
Compilers: W. L. Minckley and C. R. Gilbert.
March 1980.

Ictalurus punctatus (Rafinesque)
Channel catfish

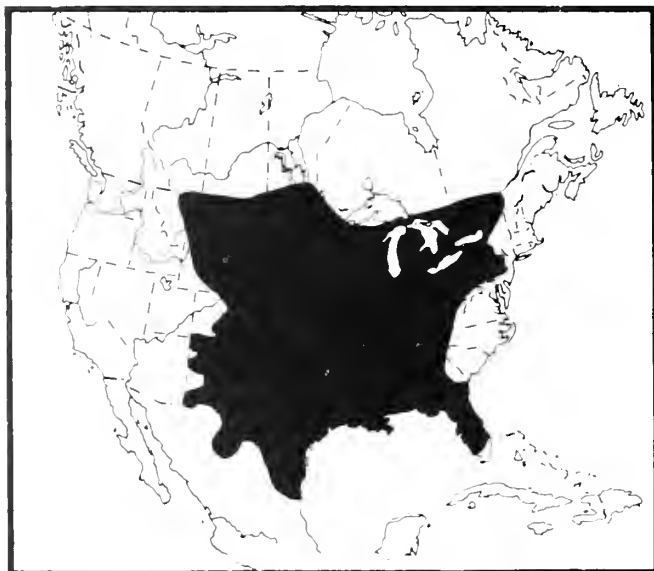
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: "Ohio River" (Rafinesque 1818. Am. Mon. Mag. Crit. Rev. 3:354-56).

SYSTEMATICS: Bailey et al. (1954. Proc. Acad. Nat. Sci. Phila. 106:109-64) discussed geographic and clinal variation but did not recognize subspecies. Possibly name-worthy forms were originally present, but situation has become greatly (perhaps hopelessly) confused by extensive introductions within and outside original range. Several closely related Mexican species, but precise relationships yet to be delineated. Most closely related United States species is *I. lupus* of TX and Mexico. Phylogenetic relationship to other ictalurids presented by Taylor (1969. U.S. Natl. Mus. Bull. 282:1-315).



MD: Cecil Co., Susquehanna River, 127 mm SL (NCSM).



Former Distribution



Present Distribution

DISTRIBUTION AND HABITAT: Native range is central drainages of United States into southern Canada, and possibly also parts of Atlantic coast. Extensive introductions onto Atlantic coast, and elsewhere, have clouded the picture. Now essentially throughout United States and much of northern Mexico. Characteristic of clear, medium to large rivers with swift currents over sand or gravel-rocky bottoms. May enter brackish waters (Scott and Crossman 1973, *Freshwater Fishes of Canada*). Common.

ADULT SIZE: 1270 mm TL maximum.

BIOLOGY: Breder and Rosen (1966. *Modes of Reproduction in Fishes*), Smith (1979. *The Fishes of Illinois*), and Scott and Crossman (1973) commented on reproduction. Simco and Cross (1966. Univ. Kans. Publ. Mus. Nat. Hist. 17:191-256) discussed fac-

tors affecting growth and production. Davis (1959. Univ. Kans. Mus. Nat. Hist. Misc. Publ. 21:1-56) commented on feeding habits. Propagation well documented by Morris (1939. Prog. Fish Cult. 44:23-27), Canfield (1947. Prog. Fish. Cult. 9:27-30), and Clemens and Sneed (1957. U.S. Fish Wildl. Serv. Special Sci. Dept. Fish 219:1-11). Occurrence of hybrids with *Pylodictus olivaris* and parasite infestation briefly discussed by Scott and Crossman (1973), as were age-weight-length relationships and oxygen, temperature and salinity tolerances. Fine structure of nasal barbel described by Joyce and Chapman (1978. J. Morphol. 158: 109-54). Diet of young and adults, growth, and fisheries information listed by Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1).

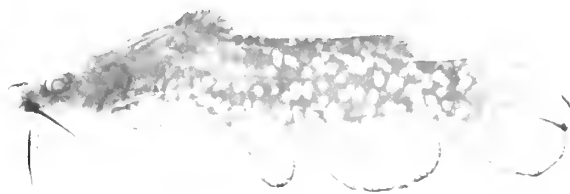
Compiler: G. S. Glodek. August 1979.

***Ictalurus serracanthus* Yerger
and Relyea
Spotted bullhead**

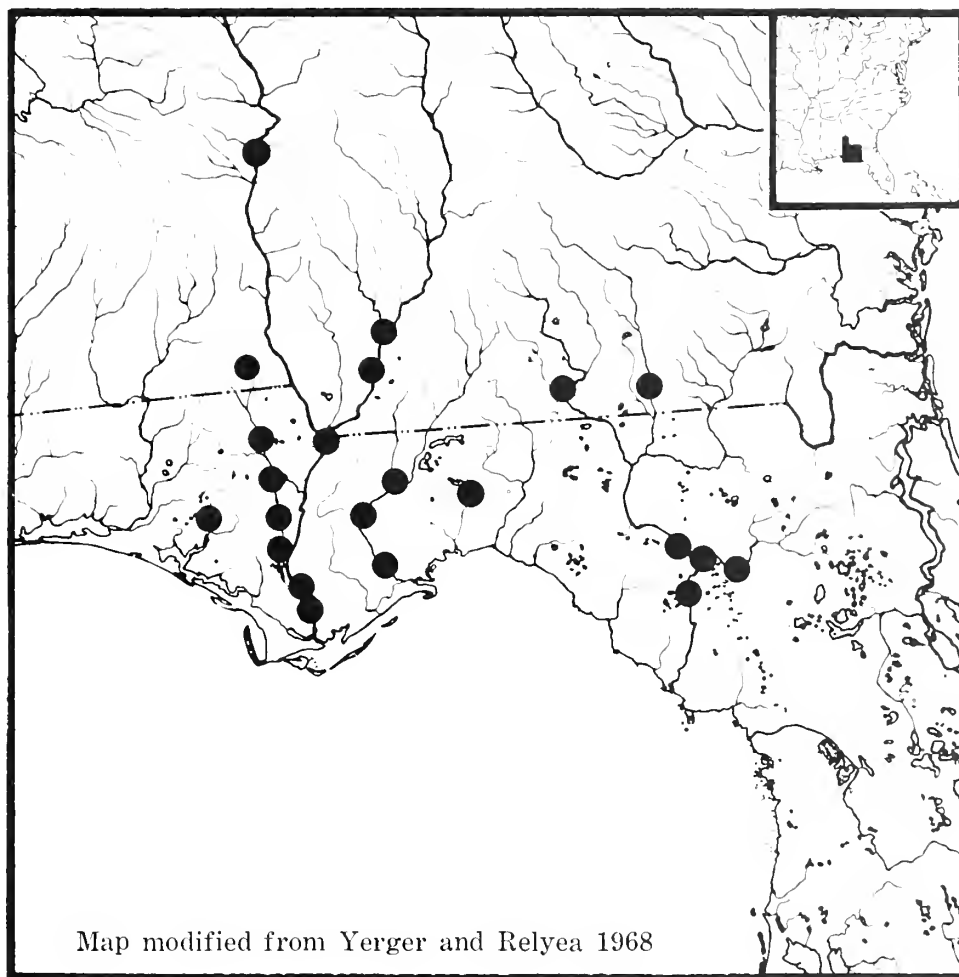
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Shore of Lake Talquin, 10.9 km wsw of Ochlockonee River bridge at U.S. hwy. 90 between Tallahassee and Quincy, T1N, R3W, Sec. 28, Gadsden Co., FL (Yerger and Relyea 1968, Copeia:361-84).

SYSTEMATICS: Although called *I. platycephalus* in early literature, closest relationships may not be with that species. Yerger and Relyea (1968) instead hypothesized a possible relationship to *I. catus*. Apparently evolved as an insular FL isolate during the Miocene-Pliocene.



FL: Wakulla Co., Sopchoppy River, 92 mm SL male (Yerger and Relyea 1968).



DISTRIBUTION AND HABITAT: Gulf Coastal Plain below Fall Line in Suwannee, St. Marks, Ochlockonee, Apalachicola, and St. Andrews Bay drainage systems of northern FL, southern GA, and southeastern AL. Fairly common in deep holes of large streams and rivers with moderate currents, rock substrates or sand bottoms in close proximity to rock. Occurrence in lakes limited to those formed by impounded rivers.

ADULT SIZE: 150-230 mm SL.

BIOLOGY: Little known. Yerger and Relyea (1968) reported mollusks as an important food item. Breeding season apparently extends from late winter to late spring.

Compiler: R. W. Yerger, July 1978.

Noturus albater Taylor
Ozark madtom

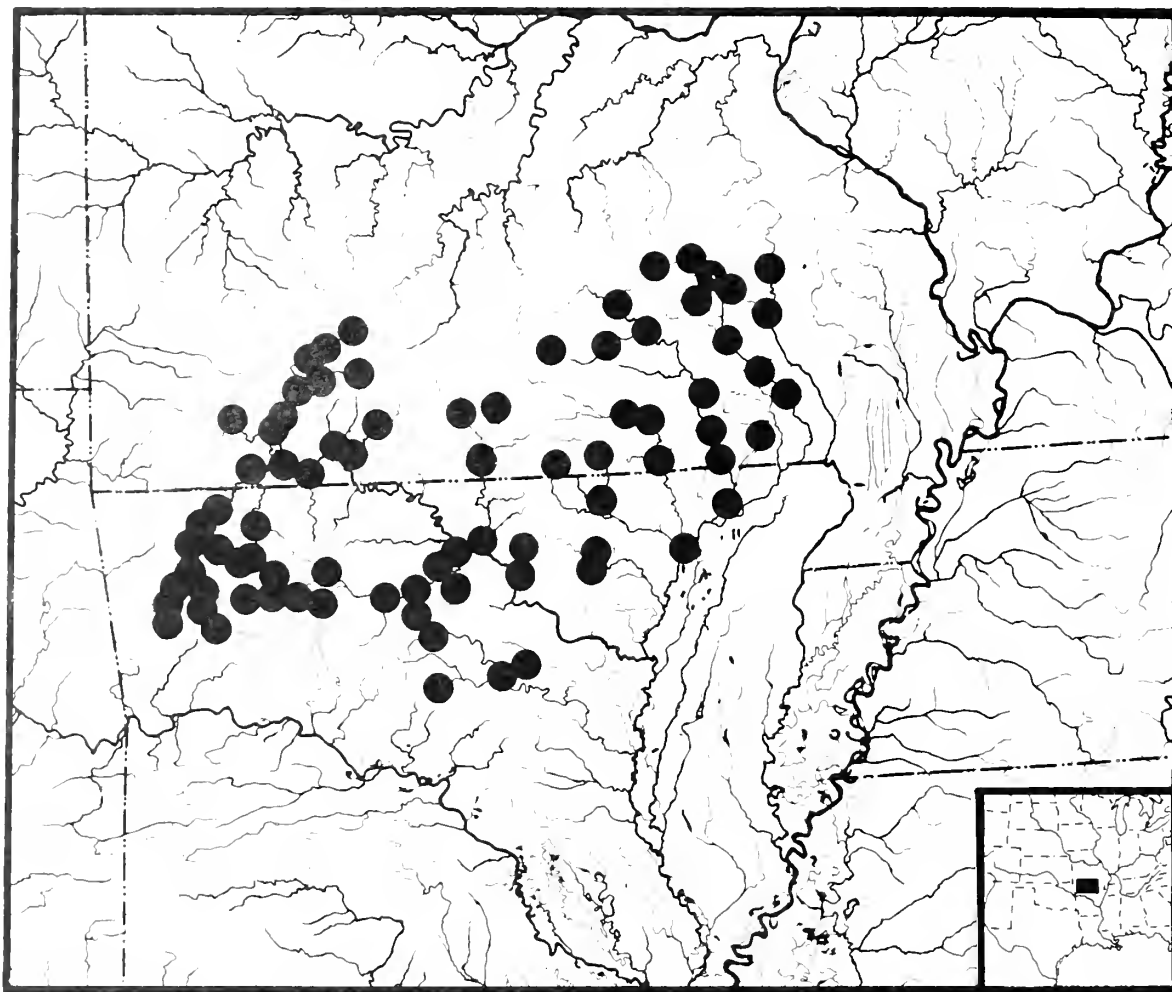
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: White River at Forsyth, on hwy. M80, Taney Co., MO (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).



SYSTEMATICS: Subgenus *Rabida*. No close affinities to other members of this subgenus (Taylor 1969).

MO: Webster Co., (Mo. Dept. Cons.)



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Known only from upper White (including Red) and St. Francis river drainages of AR and MO. Inhabits riffles and rocky pools of clear, high-gradient streams. Apparently seldom common (the largest series taken totalling 37 specimens), but this may result partly from nocturnal habits.

BIOLOGY: Pflieger (1975. *The Fishes of Missouri*) found an adult with a cluster of eggs in June and late July. The species attained a length of 33-48 mm TL by the end of its first summer. Maximum life span reported to be three years or more.

ADULT SIZE: 55-85 mm SL.

Compiler: F. C. Rohde, May 1978.

Noturus baileyi Taylor
Smoky madtom

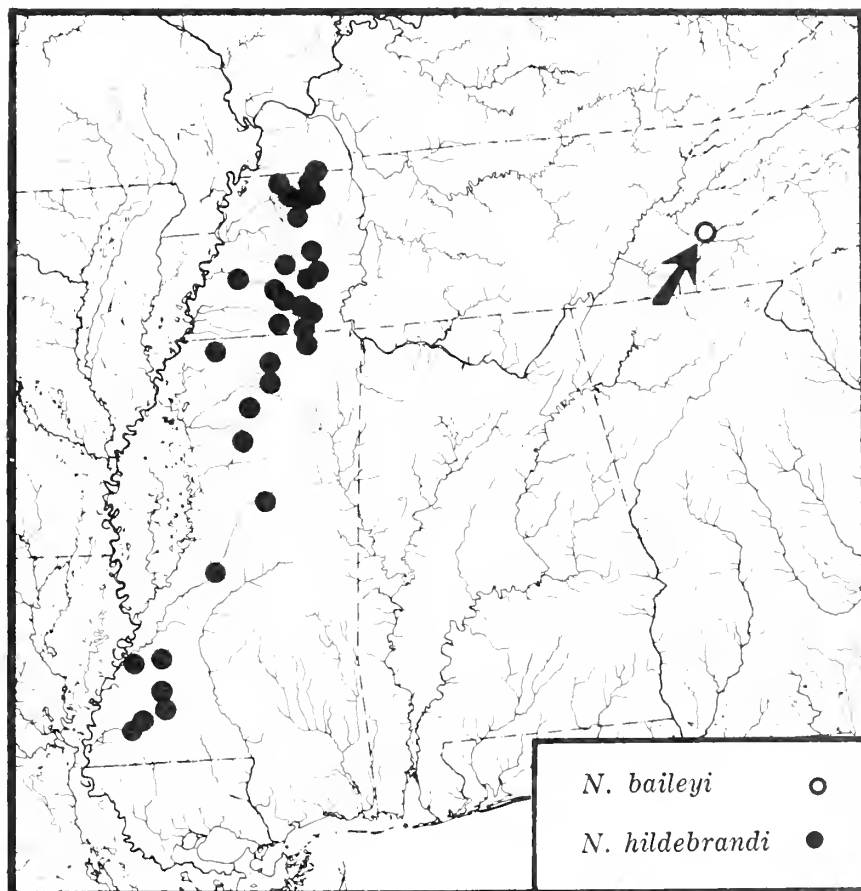
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Lower portion of Abrams Creek, Great Smoky Mountains National Park, TN (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).



(NCSM)

SYSTEMATICS: Subgenus *Rabida*. Taylor (1969) reviewed the genus *Noturus* and considered it to belong to the *N. hildebrandi* species group.



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Possibly extinct. Collected only in 1957 from the type locality. In Abrams Creek the current is moderate in the pools and swift on the riffles. Bottom consists primarily of rocks. The type specimens may have come from the Little Tennessee River proper, near the creek mouth. An intensive search in the upper Little Tennessee River system, particularly during 1977, failed to produce additional specimens (D. Etnier, pers. comm.).

ADULT SIZE: 43-49 mm SL.

BIOLOGY: Nothing known.

Compiler: F. C. Rohde. May 1978.

Noturus elegans Taylor
Elegant madtom

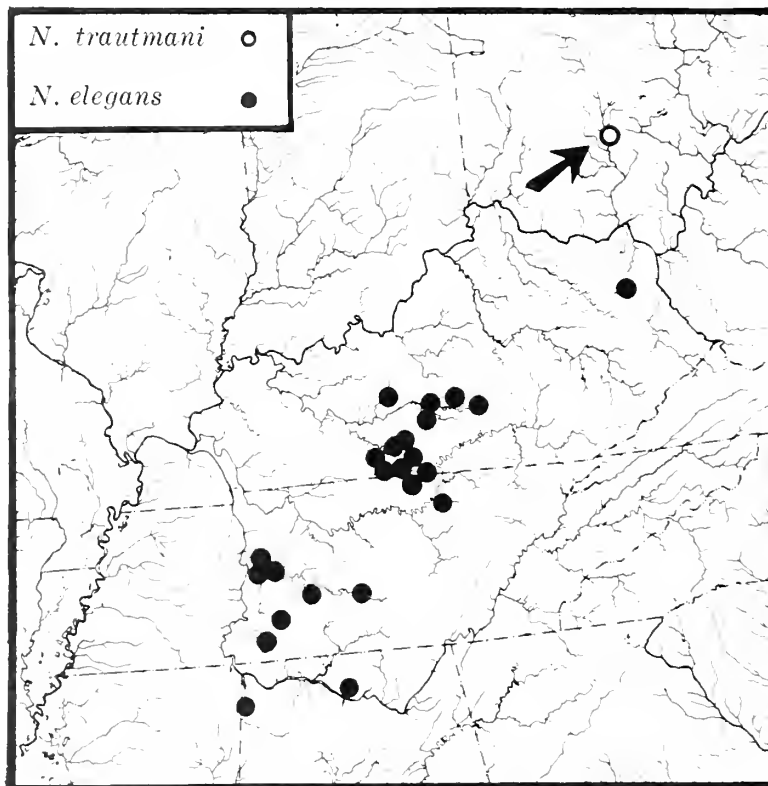
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Fallen Timber Creek at hwy. 90, 12.9 km se of Glasgow, Barren Co., KY (Taylor 1969. U. S. Natl. Mus. Bull. 282: 1-315).



(NCSM)

SYSTEMATICS: Subgenus *Rabida*. Nearest relative is *N. trautmani*, with which it forms the *N. elegans* group (Taylor 1969).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Green River system, KY, and Duck River system, TN. A few isolated collections from Cumberland and Tennessee river drainages are tentatively identified as this species. Prefers moderate riffles of clear, gravel-bottomed streams of small to moderate size.

ADULT SIZE: 40-61 mm SL.

BIOLOGY: Nothing known.

Compiler: F. C. Rohde. May 1978.

Noturus eleutherus Jordan
Mountain madtom

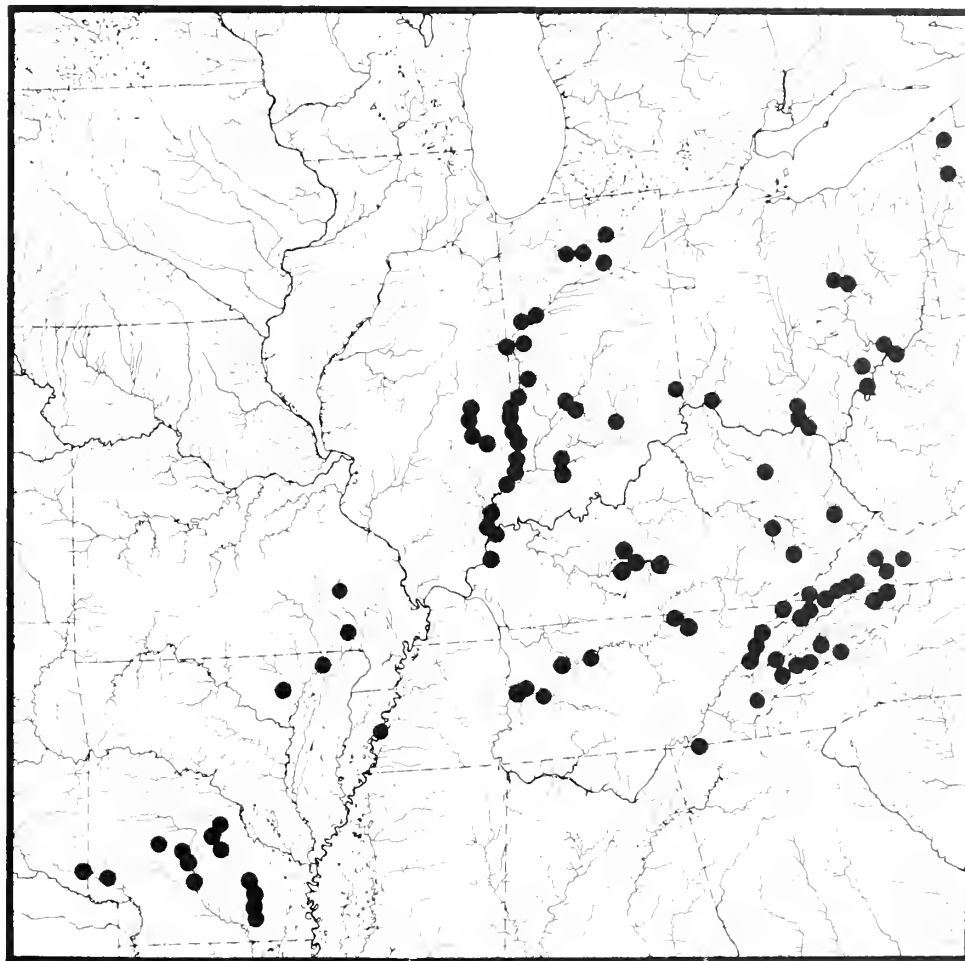
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Big Pigeon River, tributary of French Broad River, at Clifton (probably an error for near Newport, Cocke Co.), TN (Jordan 1877. Ann. N. Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Subgenus *Rabida*. Allied with *N. elegans* species group (Taylor 1969. U.S. Natl. Mus. Bull. 282:1-315).



VA: Scott Co., Copper Creek,
48 mm SL (NCSM).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Ouachita River drainage, AR, and Red River drainage, OK and AR, northeast through Ohio River basin to northwestern PA. Prefers large streams and fairly large rivers rather than creeks, where occurs in fast flowing, clear water sections over sand, gravel, and rubble. Rarely abundant; sometimes common in preferred habitat.

ADULT SIZE: 26-62 mm SL, 73 mm SL maximum.

BIOLOGY: Trautman (1957. *The Fishes of Ohio*) found that young of year ranged from 25-58 mm TL and yearlings from 36-64 mm TL in OH.

Compiler: F. C. Rohde. February 1978.

Noturus exilis Nelson
Slender madtom

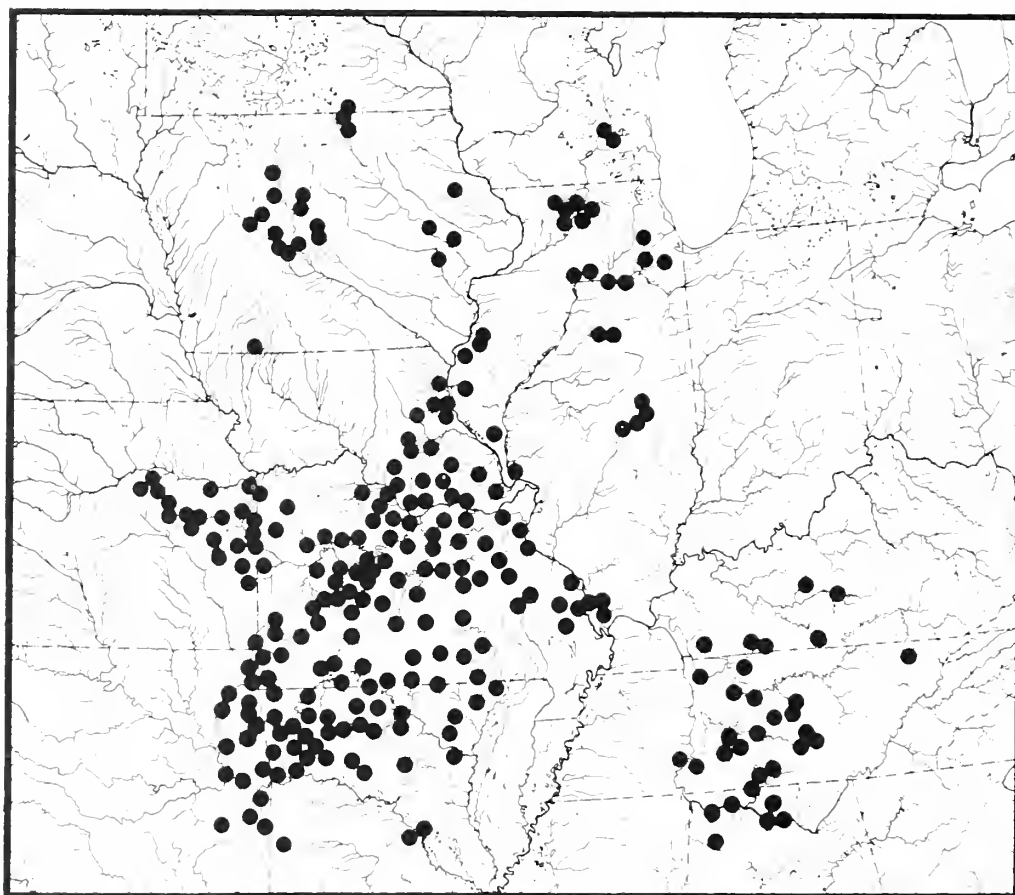
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Mackinaw Creek, McLean Co., IL (Nelson 1876. Bull. Ill. Mus. Nat. Hist. 1:33-52).



SYSTEMATICS: Subgenus *Schilbeodes*. Probably most closely related to *N. nocturnus*, with slightly more distant relationship to *N. lachneri* and *N. gyrinus* (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).

AL: Limestone Co., Tennessee
River drainage, 91 mm SL
(Smith-Vaniz 1968).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Two rather disjunct centers of distribution east and west of Mississippi River: one in Tennessee, Cumberland, and Green river drainages from northern AL to KY, second in the Ozarks in AR and OK north to southern WI and southern MN. Recent collections in Red River system of OK and AR. Lives in riffles of small to medium streams in moderate or fast current. One of the more common madtoms throughout much of its range. Less common in the southern than northern Ozarks, perhaps because of competition with other *Noturus* species.

ADULT SIZE: 76-127 mm TL.

BIOLOGY: Little known. Pflieger (1975. *The Fishes of Missouri*) found females with fully developed eggs in April and early May, suggesting a spring spawning season.

Compiler: F. C. Rohde. May 1978.

Noturus flavater Taylor
Checkered madtom

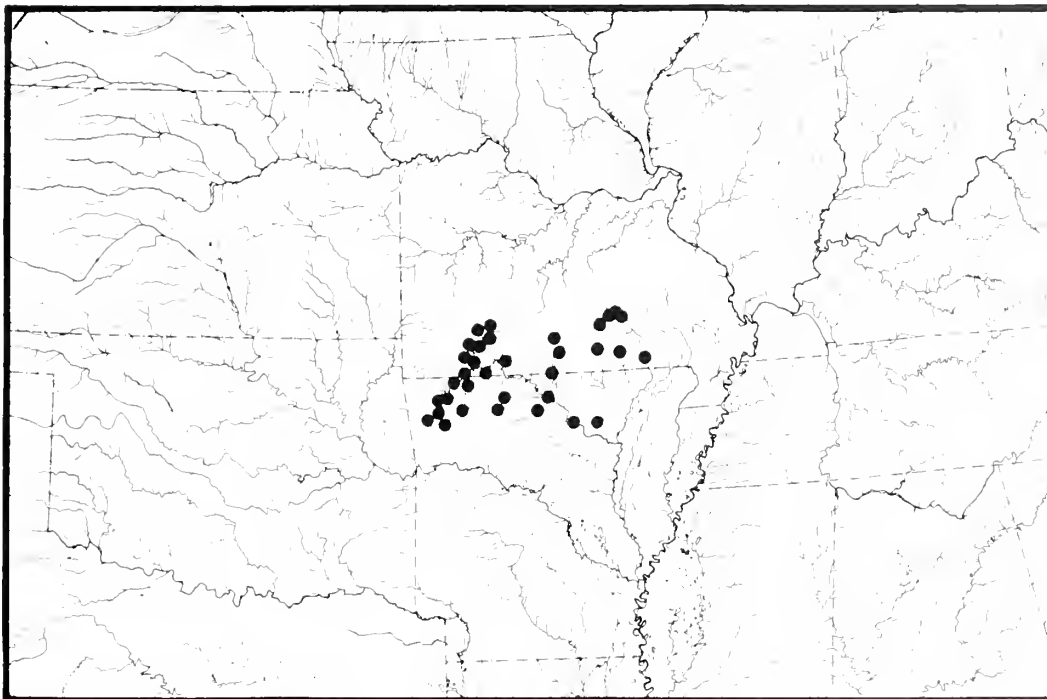
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Flat Creek, at hwy. M39, 19.4 km ne of Cassville, Barry Co., MO (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).



SYSTEMATICS: Subgenus *Rabida*. Taylor (1969) considered it most closely related to allopatric species *N. miurus* and *N. flavipinnis*.

MO: Taney Co., Beaver Creek,
88 mm SL (Mo. Dept. Cons.)



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Confined to AR and MO in southern Ozarks from upper White River east to Current River. Inhabits rivers having high gradients and strong flow, where it occurs in quiet pools or backwaters, often associated with thick deposits of organic debris. Generally uncommon.

ADULT SIZE: 30-109 mm SL, 114 mm SL maximum.

BIOLOGY: Nothing known.

Compiler: F. C. Rohde. July 1978.

Noturus flavipinnis Taylor
Yellowfin madtom

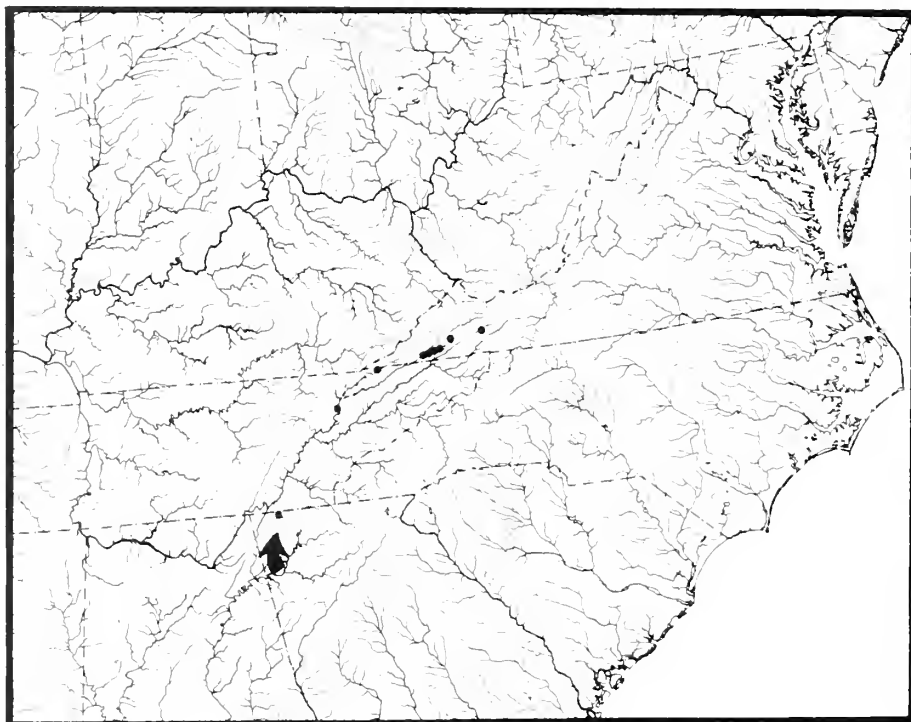
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Hines Creek, tributary to Clinch River, Clinton, Anderson Co., TN (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).

SYSTEMATICS: Subgenus *Rabida*. Placed in *N. miurus* group, with *N. miurus* and *N. flavater* (Taylor 1969). Some features suggest affinity also with members of *N. furiosus* group (Taylor et al. 1971. Proc. Biol. Soc. Wash. 83:469-76).



VA: Scott Co., Copper Creek.
55 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Upper Tennessee drainage, GA, TN, and VA, where known from Ridge and Valley province. Clearly extant only in Copper Creek, a Clinch River tributary, VA, in which it extends from the mouth through Scott Co. into Russell Co. Possibly persisting in Powell River where taken once in 1968 (Taylor et al. 1971). Two series from lower Clinch and upper Tennessee rivers, TN, taken during 1893 and originally reported as *N. miurus*, were regarded as *N. flavipinnis* by Taylor (1969); unverified and these records are not plotted herein. Occupies medium-sized streams and rivers that are warm, relatively unsilted, and of moderate gradient. Generally inhabits pools and backwaters, rarely runs.

ADULT SIZE: 60-95 mm SL.

BIOLOGY: Nocturnally active; under cover during daylight. Consumes benthic insects. Longevity three to four years, maturing after first full year following birth. Two gravid females taken in May contained 121 and 212 apparently maturing and mature ova; postspawning females collected in August.

Compiler: R. E. Jenkins. July 1978.

***Noturus flavus* Rafinesque**
Stonecat

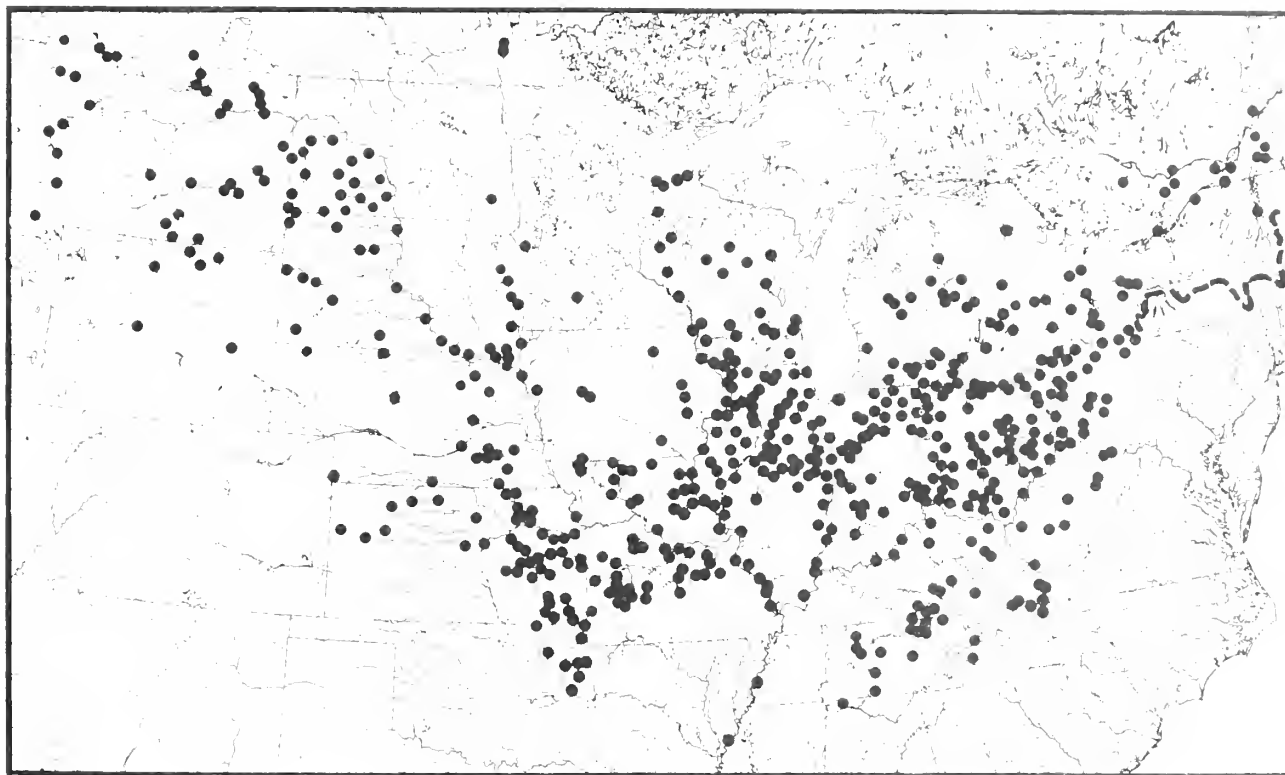
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Falls of Ohio River, OH
(Rafinesque 1818. Am. Mon. Mag. Crit. Rev.
39-42).



SYSTEMATICS: Only member of subgenus
Noturus. Closest relatives apparently are
some members of subgenus *Schilbeodes*,
particularly *N. gilberti*, *N. insignis*, and *N.*
nocturnus (Taylor 1969. U. S. Natl. Mus.
Bull. 282:1-315).

MD: Garrett Co., Casselman
River, 138 mm SL (NCSM).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT:

Throughout Mississippi River basin from
AR and AL northwest to MT, AT, and MB
and northeast through Ohio River basin to
NY, in Great Lakes-St. Lawrence River drain-
age, Mohawk system, and Hudson River
drainage. Prefers riffles or rapids in mod-
erate or large streams, but may be present
in lakes (i.e. western Lake Erie) where
stream conditions are duplicated. Sometimes
rather common, more so than most species of
Noturus.

ADULT SIZE: 76-188 mm TL, 312 mm TL
maximum.

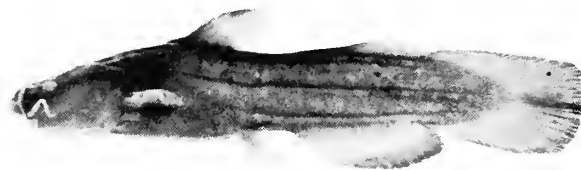
BIOLOGY: Pflieger (1975. *The Fishes of
Missouri*) found food was principally im-
mature stages of riffle-dwelling insects, but
may also include small fish. Probably spawns
in April or May in MO. Carlson (1966. Proc.
S.D. Acad. Sci. 45:131-37) discussed age and
growth and estimated maximum age of seven
years. Scott and Crossman (1973. *Fresh-
water Fishes of Canada*) summarized addi-
tional data on spawning, fecundity, age,
growth, food habits, and parasites.

Compiler: F. C. Rohde. May 1978.

Noturus funebris Gilbert and Swain
Black madtom

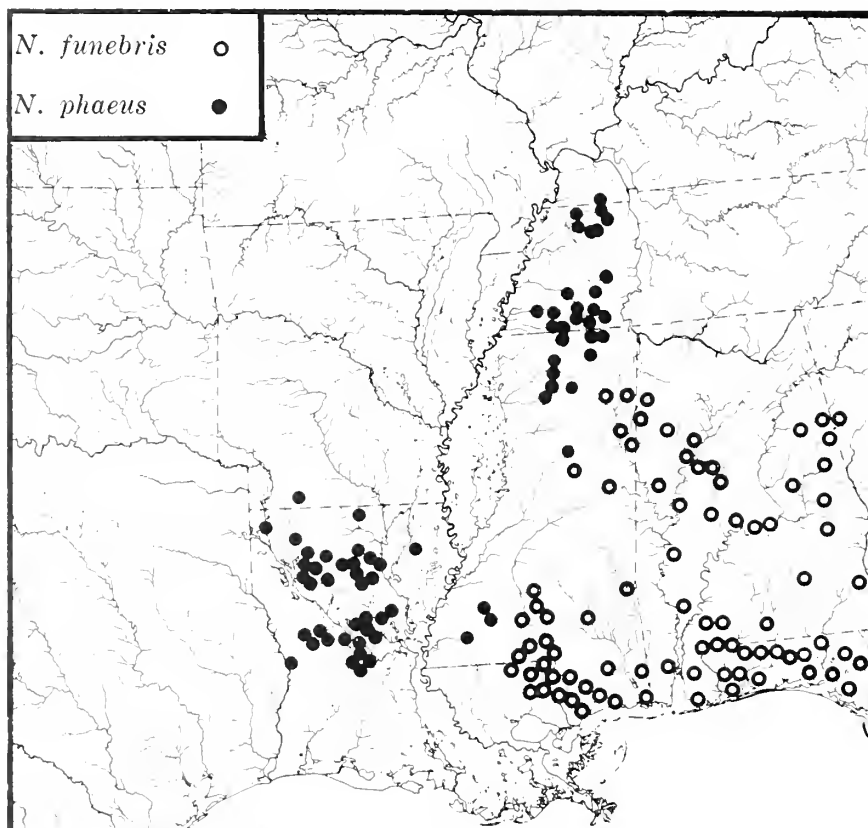
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Spring-run tributary to North River, near Tuscaloosa, AL (Gilbert and Swain in Gilbert 1891. Bull. U.S. Fish Comm. 9:143-59).



SYSTEMATICS: Subgenus *Schilbeodes*. Closely related to *N. phaeus* with which it forms a distinct species group. (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).

AL: Coosa Co., Coosa River,
52 mm SL (Smith-Vaniz 1968)



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Confined to eastern Gulf of Mexico tributaries from Pearl River system in LA and MS east to FL. Prefers small streams or creeks with moderate flow over small gravel or coarse sand bottom. Often found under vegetation. Never particularly common, but collected consistently in preferred habitat in Gulf coastal streams.

ADULT SIZE: 60-98 mm SL, 120 mm SL maximum.

BIOLOGY: Thomerson (1966. Trans. Ill. State Acad. Sci. 59:397-98) described biological aspects of this species although Taylor (1969) believed some of the conclusions to be in error.

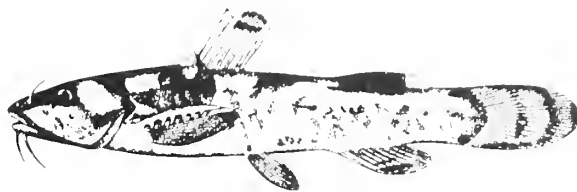
Compiler: F. C. Rohde. February 1978.

***Noturus furiosus* Jordan and Meek**
Carolina madtom

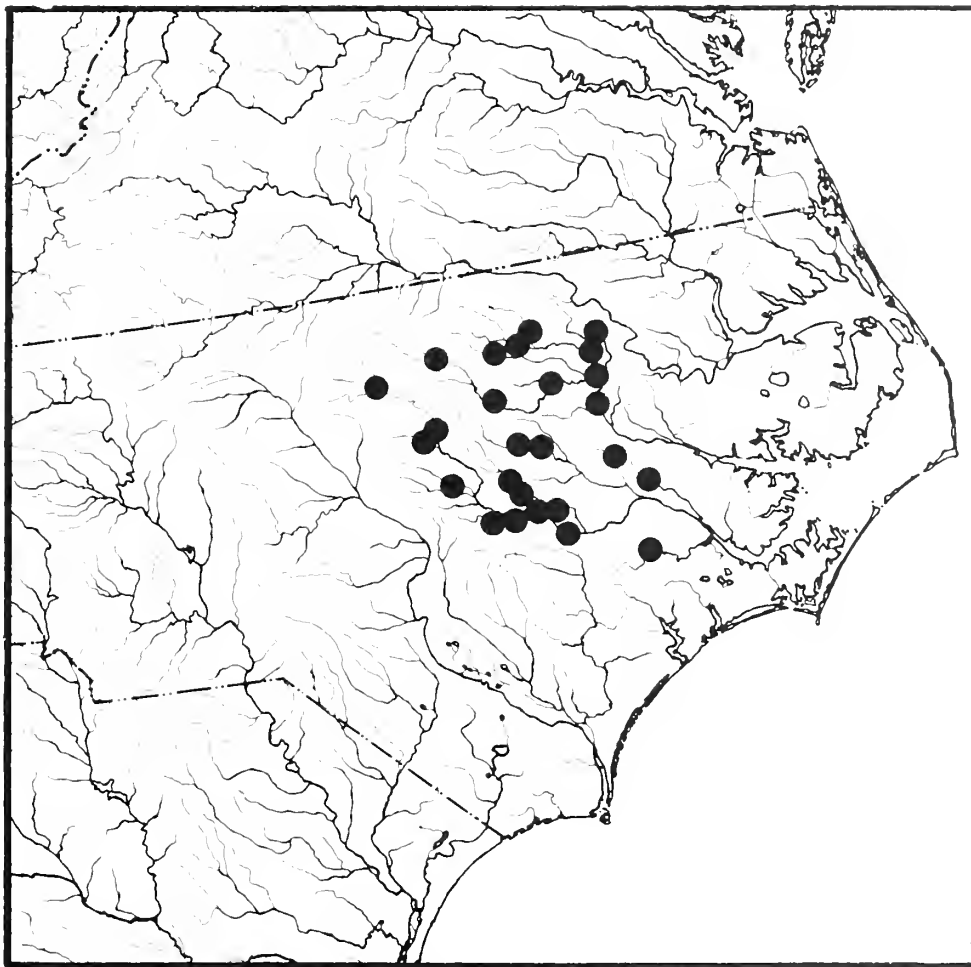
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Neuse River at Millburnie, near Raleigh, NC (Jordan and Meek in Jordan 1889 Proc. U.S. Natl. Mus. 11: 351-62).

SYSTEMATICS: Subgenus *Rabida*. Closely related to *N. munitus*, *N. placidus*, and *N. stigmatosus* of *N. furiosus* group (Taylor 1969. U.S. Natl. Mus. Bull. 282:1-315).



NC: Neuse River, Raleigh, ca. 75 mm SL (Jordan and Evermann 1900).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Endemic to Neuse and Tar river drainages, NC. Occupies Piedmont and inner Coastal Plain, with most records from vicinity of Fall Line. Widely disjunct range of *N. furiosus* from other members of species group (the closest occur in Ohio basin and Mobile River drainage) poses an interesting zoogeographical problem. Usually found in very shallow water with little or no current over fine to coarse sand bottom. Generally uncommon or rare.

ADULT SIZE: 36-84 mm SL, 100 mm SL maximum.

BIOLOGY: Nothing presently known.

Compiler: F. C. Rohde. May 1978.

Noturus gilberti Jordan and
Evermann
Orangefin madtom

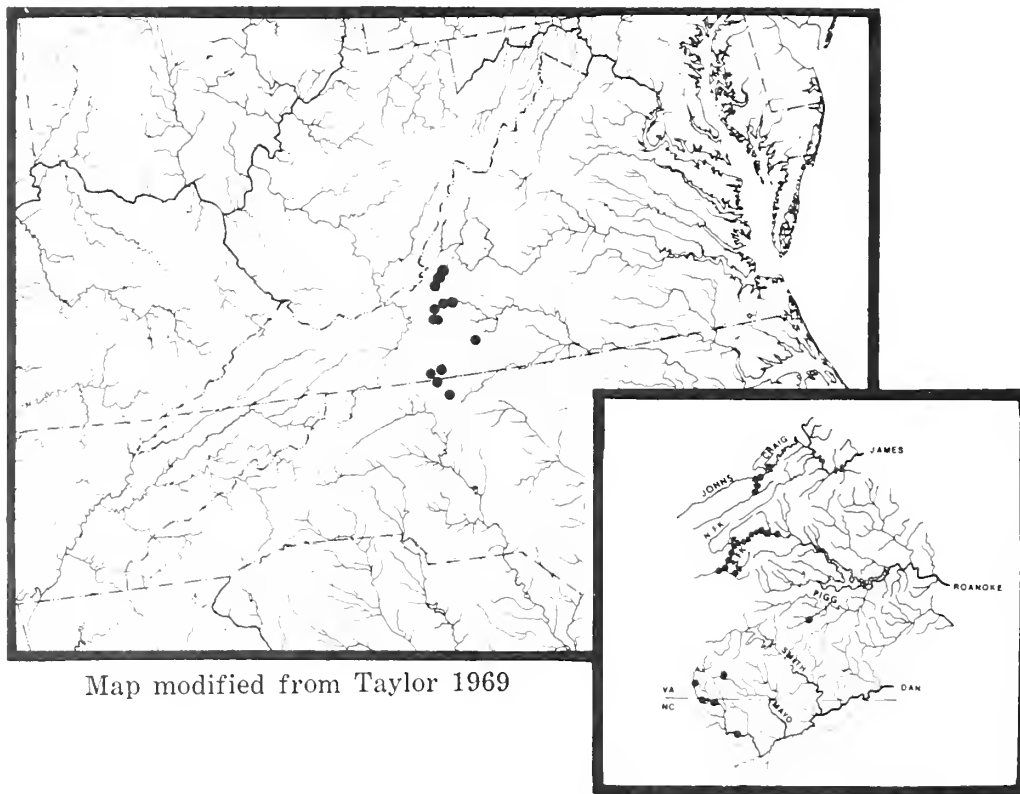
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Roanoke River, Salem, Roanoke Co., VA (Jordan and Evermann in Jordan 1889. Proc. U.S. Natl. Mus. 11:351-62). Lectotype designated by Taylor (1969. U.S. Natl. Mus. Bull. 282:1-315).

SYSTEMATICS: Subgenus *Schilbeodes*. Very distinct species, apparently not closely related to any other of genus, but resembles *N. flavus* of monotypic subgenus *Noturus* (Taylor 1969).



VA: Montgomery Co., South Fork Roanoke River, 86 mm TL (NCSM).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Widely but disjunctly distributed in Ridge and Valley and upper Piedmont of upper Roanoke drainage, including Roanoke proper and Dan systems, VA and NC. At least one population (Mayo River of Dan system) probably extirpated. Occupies middle section of Craig Creek system, upper James drainage, VA, where it possibly was introduced. Inhabits riffles and runs of medium to large, cool to warm, usually clear streams; lives under large gravel, rubble and probably boulders and other cover. Generally uncommon to rare.

ADULT SIZE: 60-80 mm SL.

BIOLOGY: Feeds at least largely on immature benthic insects. Nocturnal. Life span ca. three years, spawning in one or two of those years during May and June and possibly late April. Fecundity low (51-62 ova in four specimens) and eggs large (2.3-3.3 mm diameter).

Compiler: R. E. Jenkins. July 1978.

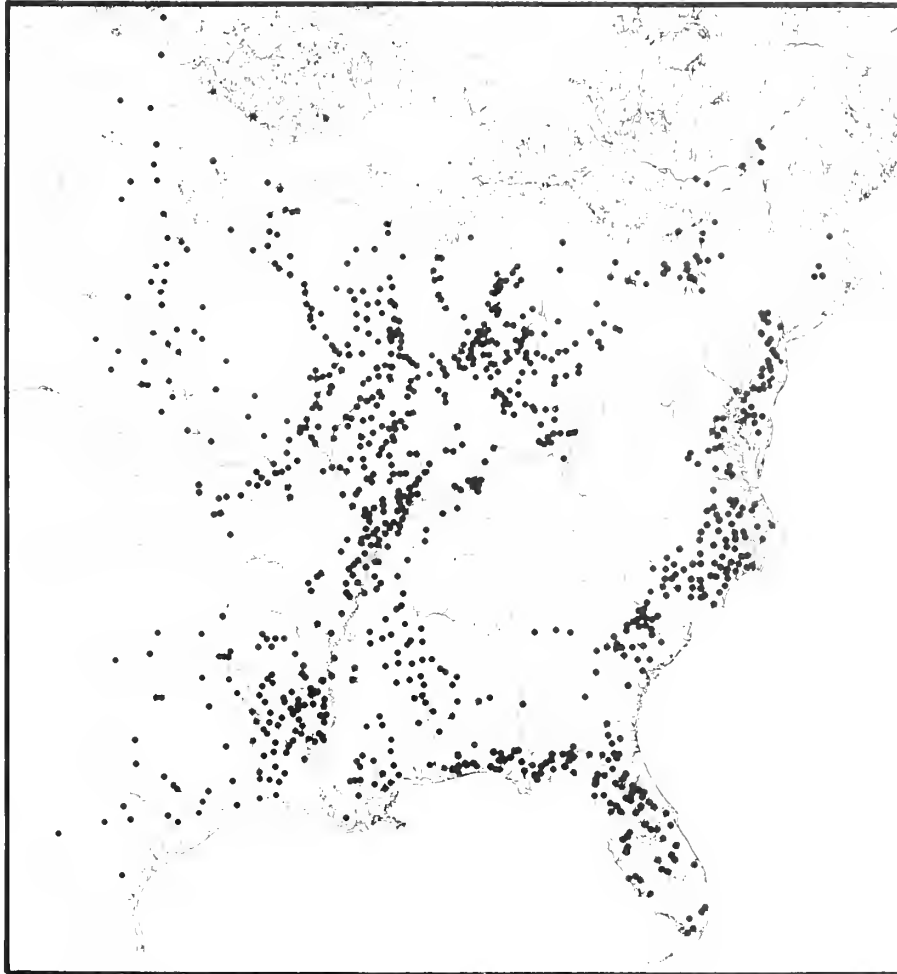
Noturus gyrinus (Mitchill)
Tadpole madtom

Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Wallkill River, NY (Mitchill 1817. Am. Monthly Mag. Crit. Rev. 1: 289-90).

SYSTEMATICS: Subgenus *Schilbeodes*. Appears to be most closely related to *N. lachneri* (Taylor 1969. U.S. Natl. Mus. Bull. 282:1-315).

MD: St. Mary's Co., St. Mary's River (NCSM)



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Gulf slope from TX to FL and along the Atlantic Coastal Plain to NY (also introduced, presumably, in MA and NH); north in Mississippi and Missouri Valleys to MN and in Red River of North in ND and MB, east to QU. Absent from Appalachian highlands from northern AL to NY. Introduced into some areas. Typically inhabits quiet or slow-moving waters, especially over soft, muddy bottom with extensive vegetation. Often abundant where found.

ADULT SIZE: 24-60 mm SL; 104 mm SL maximum.

BIOLOGY: Feeds primarily on insect larvae, crustaceans, and occasionally small fish (Adams and Hankinson 1928. Roosevelt Wild Life Ann. 1:1-548). Spawns in MO and MS in June or July. Attains a length of ca. 30-56 mm by end of first summer. Most individuals mature in second year with few living beyond the third (Pflieger 1975. *The Fishes of Missouri*). Mahon (1977. Can. Field-Nat. 91:292-94) studied age and fecundity. Todd (1973. Proc. Acad. Sci. Affil. Soc. 83:19) commented on some aspects of natural history. Parasites examined by Dechtiar (1972. J. Fish. Res. Board Can. 29:275-83).

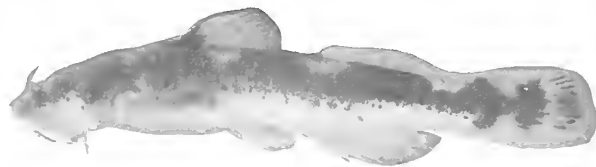
Compiler: F. C. Rohde. July 1978.

Noturus hildebrandi (Bailey and Taylor)
Least madtom

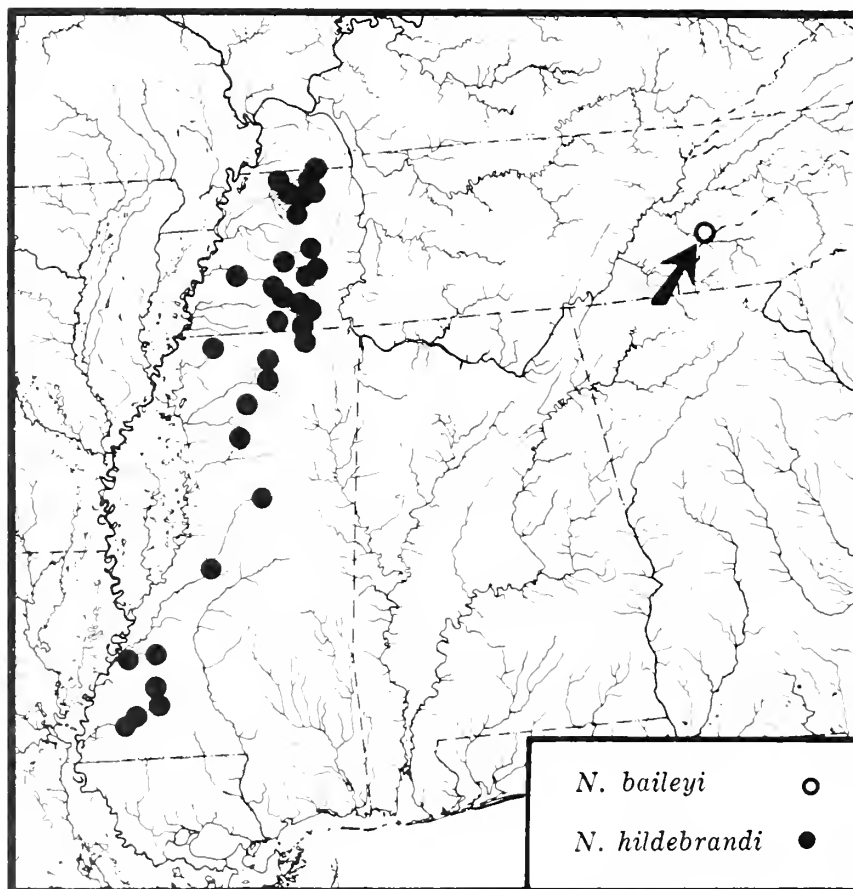
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Brushy Creek, 1.6 km above its mouth in Homochitto River, at village of Homochitto, 6.5 km ne of Coles, T4N, R2E, Sec. 14, Amite Co., MS (Bailey and Taylor 1950. Copeia:31-38).

SYSTEMATICS: Subgenus *Rabida*. *N. h. hildebrandi* and *N. h. lautus* are the only subspecies recognized. They intergrade in north central MS and southwest TN (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315). Has disjunct, close relatives in Tennessee River drainage (*N. baileyi* and an undescribed species).



TN: Henry Co., Obion River,
41 mm SL (J. L. Harris).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: *Noturus h. hildebrandi* ranges from Homochitto River drainage north in MS (but apparently absent from Black River drainage). *N. h. lautus* is known only from TN and the Hatchie River, northeast MS. *N. h. hildebrandi* is generally found in relatively shallow, clear riffles with moderate current. *N. h. lautus* was taken in moderately deep streams with a slower current over bottoms of shifting sand (Taylor 1969). Not especially common, but more so than many *Noturus*.

ADULT SIZE: 27-47 mm SL.

BIOLOGY: Nothing known.

Compiler: F. C. Rohde. May 1978.

Noturus insignis (Richardson)
Margined madtom

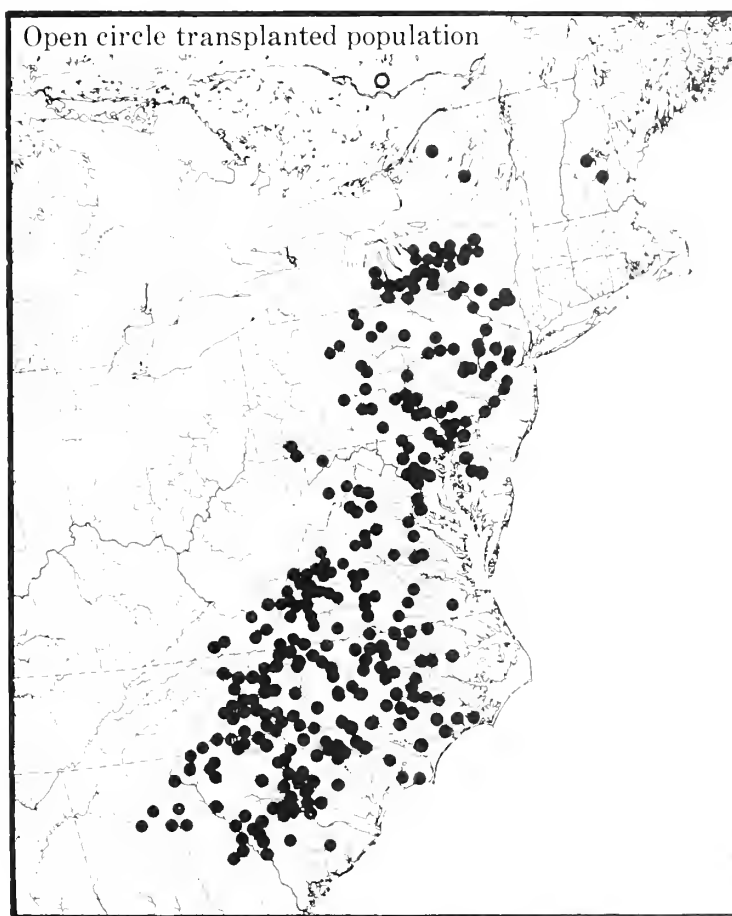
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Philadelphia, (PA), U. S. (Richardson 1836. *Fauna Boreali-Americana*).

SYSTEMATICS: Subgenus *Schilbeodes*. Apparently most closely related to *N. nocturnus* (Taylor 1969. U.S. Natl. Mus. Bull. 282: 1-315). Superficially similar to *N. exilis*, but relationships less intimate (Taylor 1969). Referred to as *Noturus* or *Schilbeodes marginatus* in some older references (Hubbs and Raney 1944. Occas. Pap. Mus. Zool. Univ. Mich. 487:1-36). Some references to *N. insignis* may refer to *N. leptacanthus*, *N. flavus*, *N. miurus*, or especially *N. exilis*.



MD: Baltimore Co., Gunpowder drainage (NCSM)



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Native range apparently from southeastern Lake Ontario drainage, south on Atlantic slope from NY to GA; also found in upper Kana-wha (New) River, upper Ohio River basin and upper Tennessee River tributaries. Apparently introduced in Merrimack River, NH and Clark Lake, Gogebic Co., MI (Taylor 1969). Michigan record not shown. Chiefly in clearwater streams of moderate current. Usually about riffles of gravel and rubble, where often very common.

ADULT SIZE: 47-90 mm SL, 130 mm SL maximum.

BIOLOGY: Clugston and Cooper (1960. Copeia:9-16) studied age and growth in PA. Individuals usually live three years and occasionally four. Little data available on food habits. Flemer and Woolcott (1966. Chesapeake Sci. 7:75-89) reported insects and unidentified fish in three individuals.

Compiler: F. C. Rohde. February 1978.

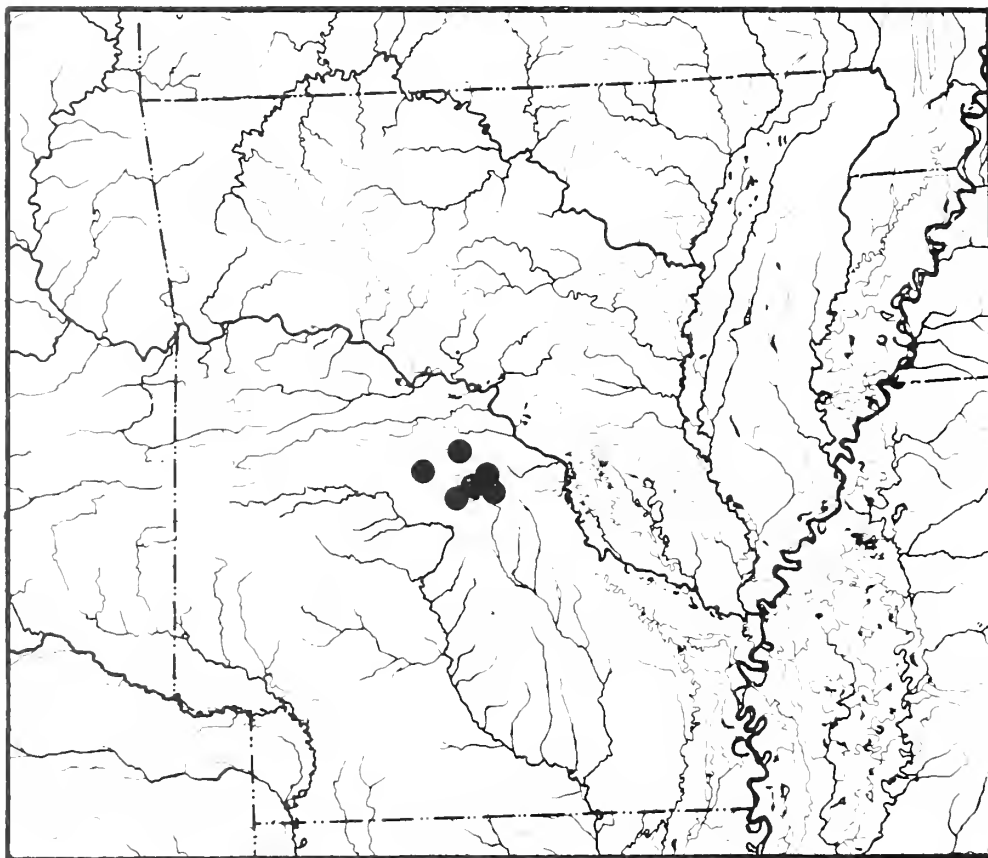
Noturus lachneri Taylor
Ouachita madtom

Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Middle Fork of Saline River at AR state hwy. 7, 18.1 km n of Mt. Valley, Garland Co., AR (Taylor 1969. U.S. Natl. Mus. Bull. 282:1-315).

SYSTEMATICS: Subgenus *Schilbeodes*. Taylor (1969) determined closest relatives to be *N. exilis* and *N. gyrinus*.

AR: Saline Co., Ten mile creek.
60 mm TL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to upper Saline River system (Ouachita River drainage), AR. Characteristic of small to medium-sized, moderate gradient streams with clear, cool water, gravel and rubble bottoms, and alternating pools and riffles. Seems to prefer shallow pools.

BIOLOGY: Except for cursory remarks by Taylor (1969), based on 12 specimens, little additional data have been published on this species. Robison (1974. Arkansas Acad. Sci. Proc. 28:62) and Buchanan (1974. in *Arkansas Natural Area Plan*) both regard this madtom as endangered.

ADULT SIZE: 23-66 mm SL, 69.5 mm SL maximum.

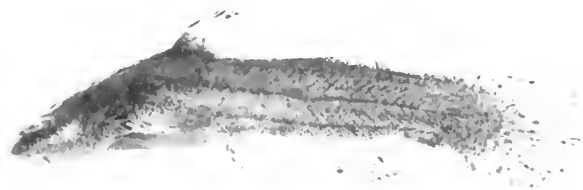
Compiler: H. W. Robison. May 1978.

Noturus leptacanthus Jordan
Speckled madtom

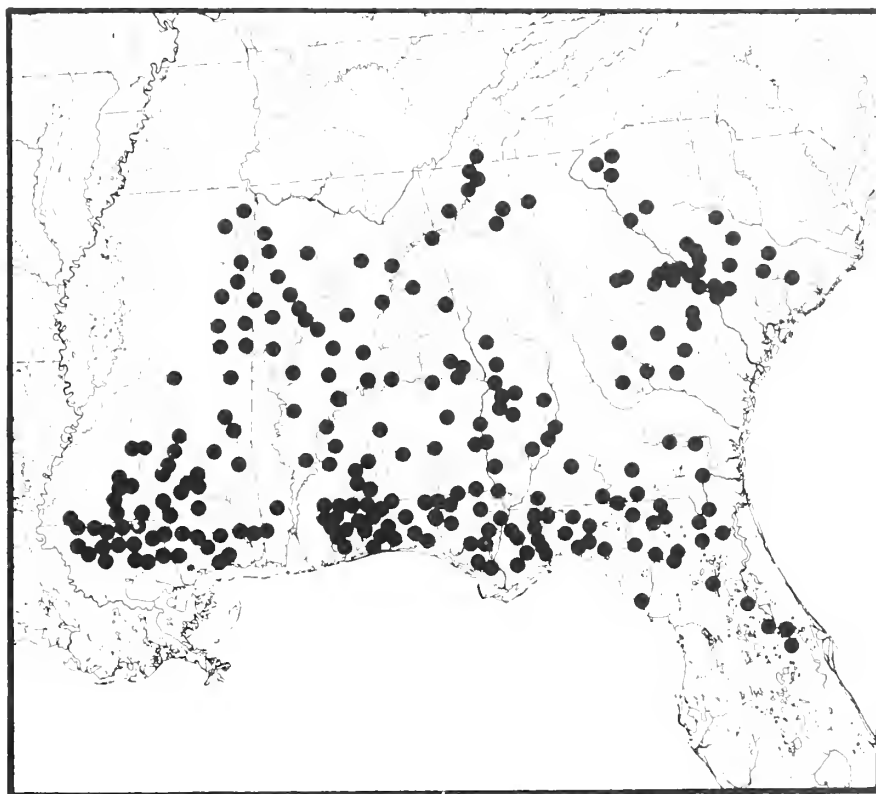
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Silver Creek, 1.6 km above jet. with Etowah River, GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Subgenus *Schilbeodes*. Morphology points to early divergence from most members of that group. Closely related to undescribed Broadtail madtom of NC and SC (Jenkins and Palmer 1978. Abstr., ASB Bull. 25:57). Apparently not intimately related to other members of genus.



SC: Aiken Co., Savannah River System, 59 mm SL (Smith-Vaniz 1968).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Occurs in both Atlantic and Gulf slope drainages from Edisto River, SC, to Amite-Comite River system LA. In peninsular FL, ranges south into upper St. John's River system. Inhabitant of small-to-moderate sized creeks, usually in moderate current over coarse sand or gravel bottom. Often common in preferred habitat.

ADULT SIZE: 31-78 mm SL, 78.7 mm SL maximum.

BIOLOGY: Clark (1977. ASIH Abstr., 57th Annual Meeting) reported on reproductive biology in southern MS. Between 15-30 eggs are deposited in a single clutch in July and August. Some evidence of females spawning twice, but few survive to a second spawning season.

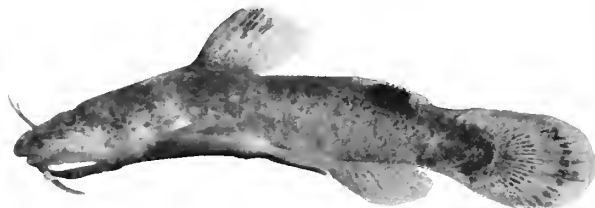
Compiler: F. C. Rohde. July 1978.

Noturus miurus Jordan
Brindled madtom

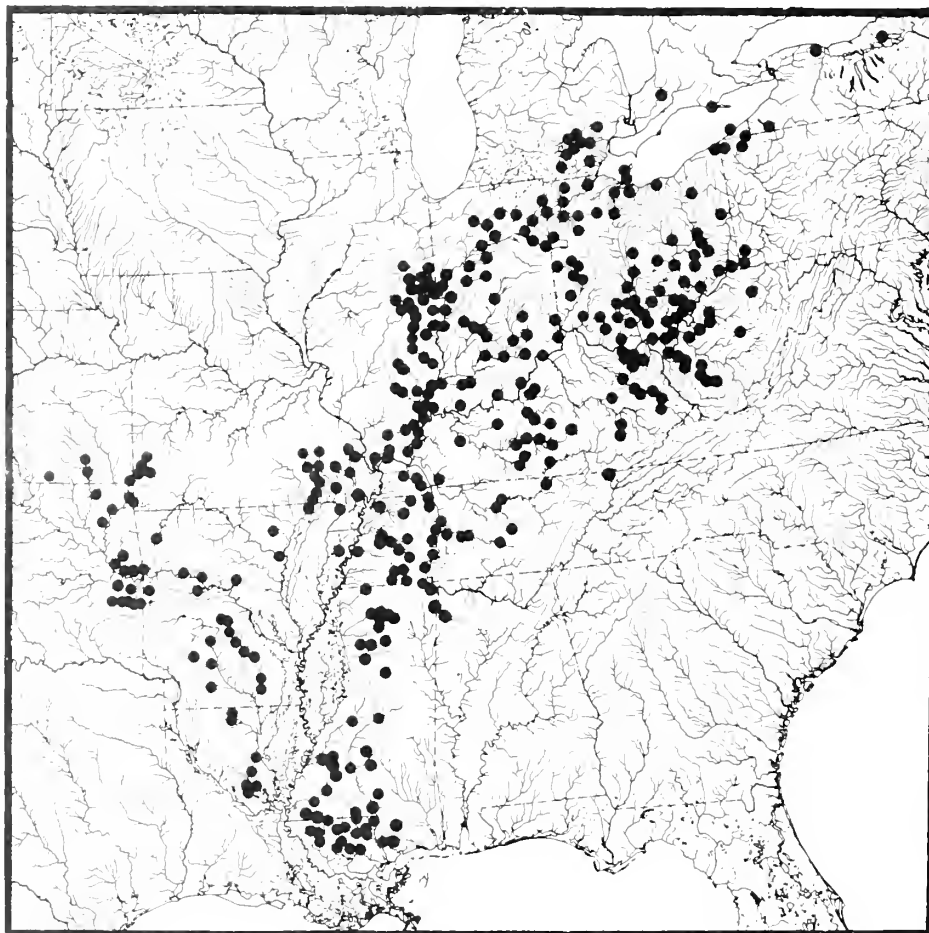
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: White River near Indianapolis, IN (Jordan 1877. Ann. N. Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Subgenus *Rabida*. Associated with *N. flavater* and *N. flavipinnis* in the *N. miurus* species group. Known to hybridize with *N. gyrinus* and *N. exilis* (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).



MO: Stoddard Co., Bell City,
68 mm SL (Mo. Dept. Cons.)



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Great Lakes (Lake Erie and Lake Ontario drainages only), lower half of Mississippi River basin, most of Ohio River basin, and Pearl River and Lake Pontchartrain drainages on central Gulf slope. Avoids clear, cold, fast water and rock and gravel riffles. In lowland or base-level streams with some current, especially in pools below riffles and in lakes. Prefers soft bottom. Seldom in large numbers, but not uncommon in central parts of range.

ADULT SIZE: 56-89 mm TL.

BIOLOGY: Taylor (1969) discussed reproduction and early development. Trautman (1957. *The Fishes of Ohio*) reported that young of the year in OH during October are 25-56 mm TL, 36-64 mm TL at one year, and 36-97 mm TL as adults (2-3 years). Scott and Crossman (1973. *Freshwater Fishes of Canada*) summarized known biological data. Menzel and Raney (1973. Am. Midl. Nat. 90: 165-76) discussed ecology of this species and *N. gyrinus*.

Compiler: F. C. Rohde. May 1978.

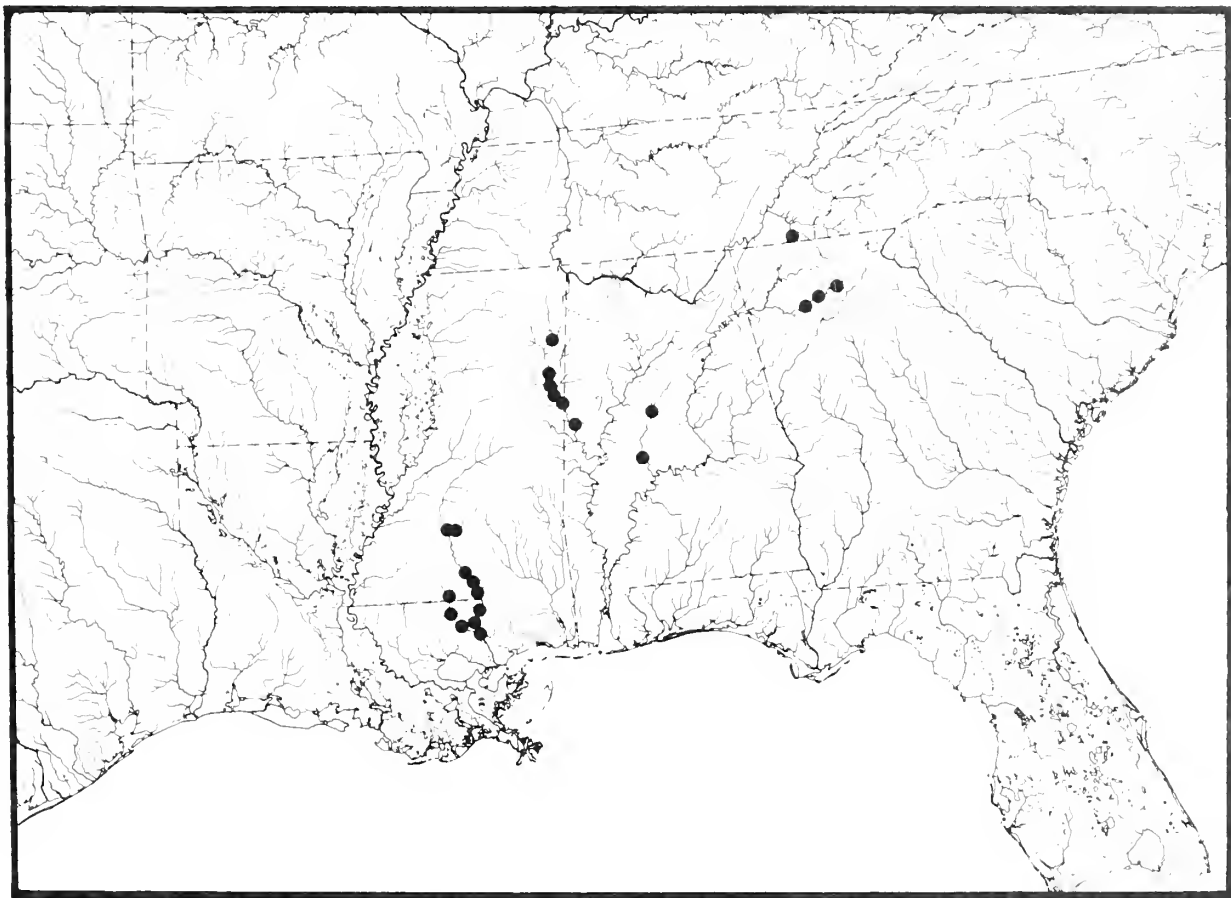
***Noturus munitus* Suttkus and
Taylor**
Frecklebelly madtom

Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Pearl River, 4.2 km e of Sandy Hook, Marion Co., MS (Suttkus and Taylor 1965. Proc. Biol. Soc. Wash. 78:169-78).

SYSTEMATICS: Subgenus *Rabida*. Most closely related to species of the *N. furiosus* group: *N. furiosus*, *N. stigmatosus*, and *N. placidus* (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).

MS: Clay-Lowndes Co.,
Tombigbee River system,
40 mm SL (Smith-Vaniz 1968).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Pearl River, LA and MS, Tombigbee River, MS and AL, Cahaba River, AL, and Conasauga River, TN. Isolated nature of population indicates a former wider distribution in Mobile Bay drainage. Chiefly in riffles and rapids of rivers and their larger tributaries. Has been taken in large numbers in lower Pearl River (night collections) and was formerly common in parts of Mobile Bay drainage. Has declined precipitously in recent years, particularly in Mobile Bay drainage where it is approaching extirpation.

ADULT SIZE: 35-75 mm SL.

BIOLOGY: Nothing known.

Compiler: F. C. Rohde. May 1978.

Noturus nocturnus Jordan and
Gilbert
Freckled madtom

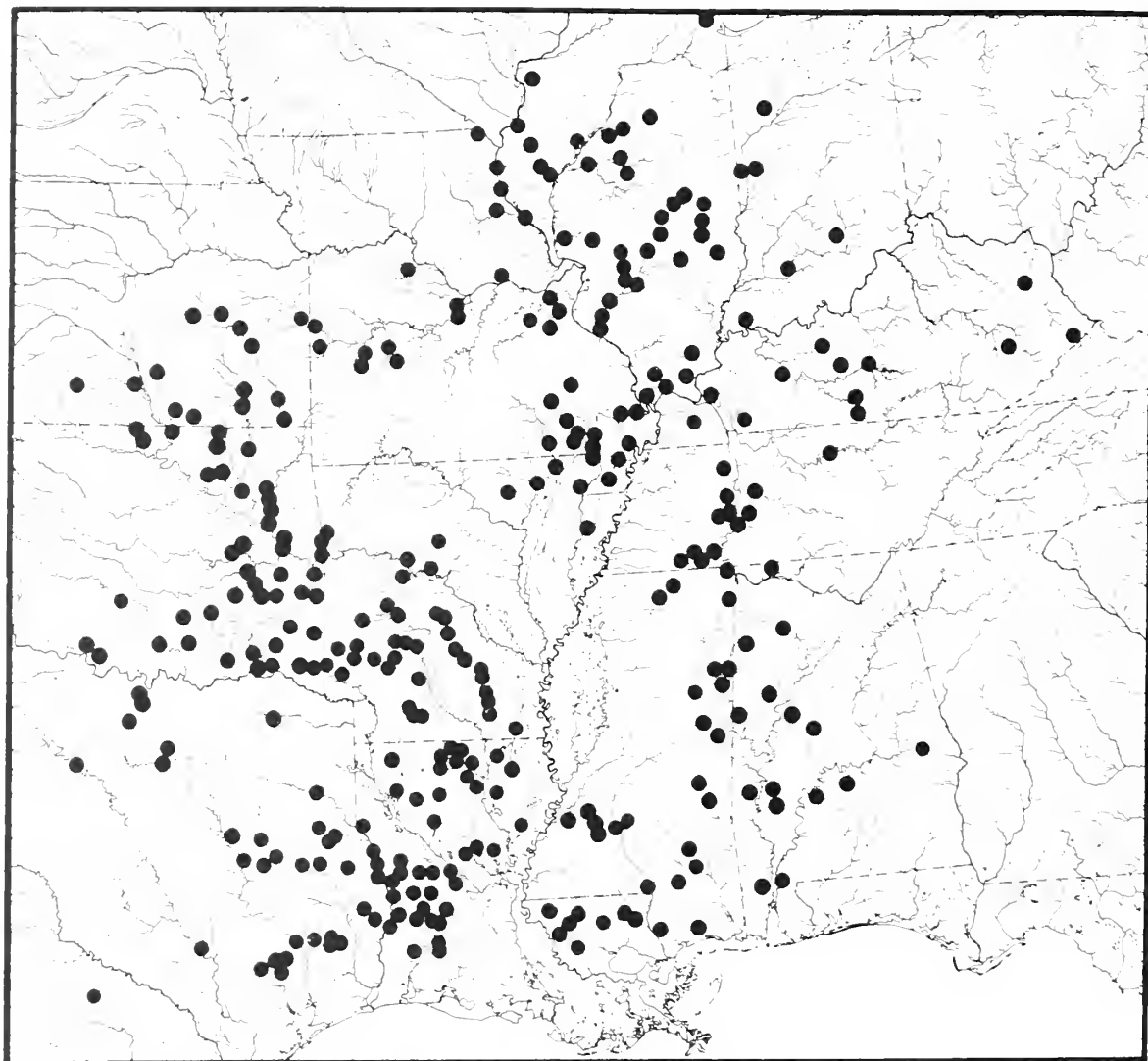
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Saline River near Benton railroad bridge, AR (Jordan and Gilbert 1886. Proc. U. S. Natl. Mus. 9:1-25.)

SYSTEMATICS: Subgenus *Schilbeodes*. Appears most closely related to *N. insignis* (Taylor 1969. U. S. Natl. Mus. Bull. 282: 1-315).



MO: Stoddard Co., Bell City,
48 mm SL (Mo. Dept. Cons.).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Lower and central Mississippi basin and other Gulf of Mexico tributaries in AL, MS, LA, and TX. Also in lower half of Ohio basin in KY, IN, and IL. Inhabits clear to moderately turbid streams of medium to large size having permanent flow and low to moderate gradients. In riffles over gravelly or rocky bottom. Seldom found in large numbers, but not uncommon in more central part of range, particularly west of Mississippi River.

ADULT SIZE: 35-56 mm SL.

BIOLOGY: Little published. In southeast MO females with fully developed eggs were collected in late May, suggesting a spring or early summer spawning season (Pflieger 1975. *The Fishes of Missouri*).

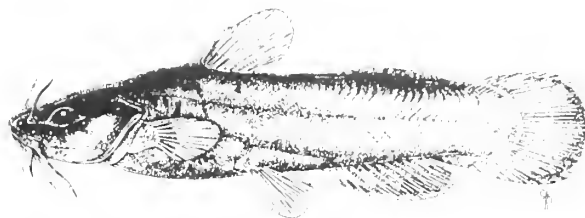
Compiler: F. C. Rohde. May 1978.

Noturus phaeus Taylor
Brown madtom

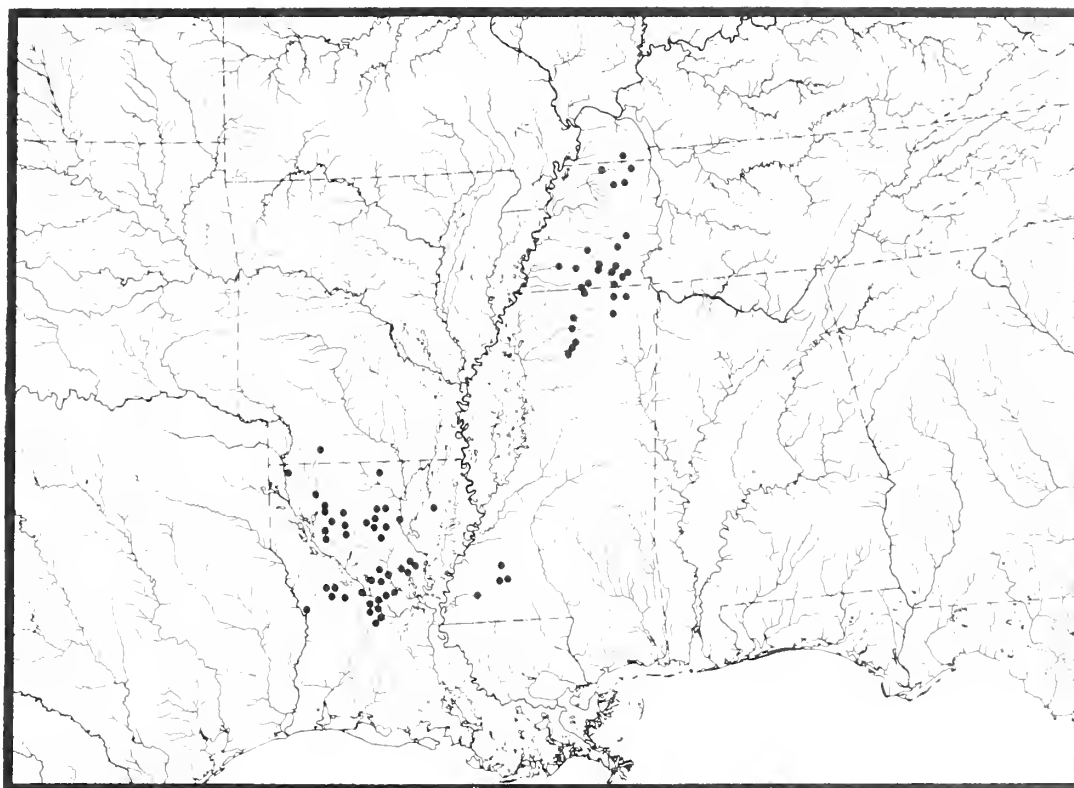
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: North Fork of Obion River at state hwy. 69, Henry Co., TN (Taylor 1969. U.S. Natl. Mus. Bull. 282: 1-315).

SYSTEMATICS: Subgenus *Schilbcodes*. Closely related to *N. funebris*, and less so to *N. insignis* and *N. nocturnus* (Taylor 1969).



MS: Marshall Co., Mimosa Spa, 77 mm SL (NCSM).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Disjunct distribution in lower Mississippi Valley in LA, southwestern MS, southern AR and northeastern MS, western TN, and southwestern KY. Also in Bayou Teche as result of recent diversion of streams from Red River. Recently collected in a tributary of Sabine River in LA. Usually in permanent springs and small streams with vegetation and moderate to fast water. Not common and most collections consist of only a few individuals.

ADULT SIZE: 43-95 mm SL.

BIOLOGY: Nothing known.

Compiler: F. C. Rohde. May 1978.

***Noturus placidus* Taylor**
Neosho madtom

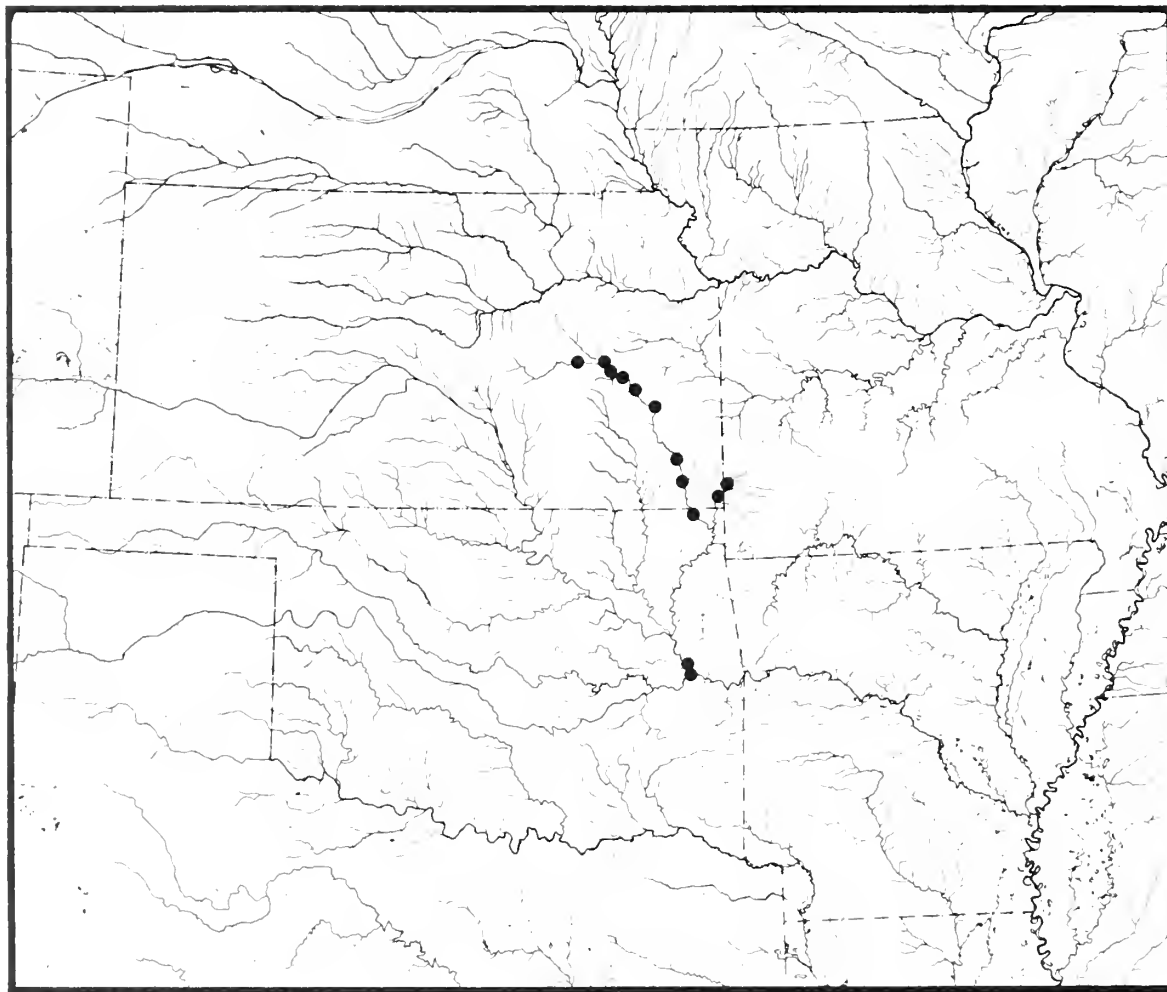
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Neosho River, just s of U. S. hwy. 50, near Emporia, T19S, R12E, Sec. 7, Lyon Co., KS (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).

SYSTEMATICS: Subgenus *Rabida*. Member of *N. furiosus* species group: *N. furiosus*, *N. stigmosus* and *N. munitus* (Taylor 1969.).



(NCSM)



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Cottonwood River, KS, throughout the Neosho River below Emporia, KS, and in lower Spring River, KS and MO. Also in lower few miles of Illinois River, OK. A riffle fish that lives under rocks, usually in clear water. Generally not very common and usually vulnerable to effects of drought and pollution. May fluctuate from moderately common to absent at a specific locality.

ADULT SIZE: 34-49 mm SL.

BIOLOGY: Little known. Cross (1967. *Handbook of Fishes of Kansas*) reported three age classes.

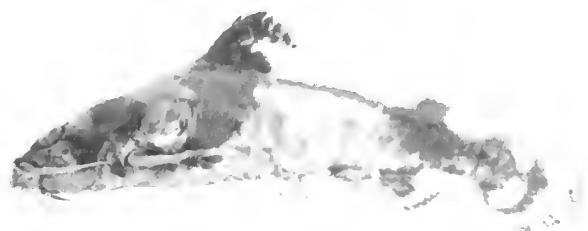
Compiler: F. C. Rohde. May 1978.

Noturus stigmosus Taylor
Northern madtom

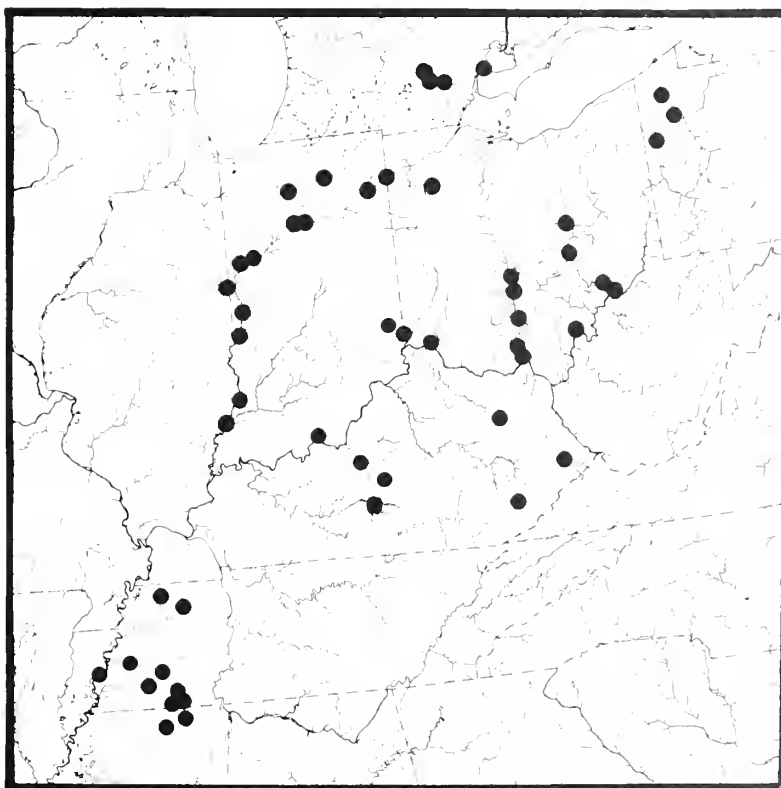
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Huron River, just south of pool, below North Territorial Road n of Dexter, T1S, R4E, Sec. 13, Washtenaw Co., MI (Taylor 1969. U.S. Natl. Mus. Bull. 282:1-315).

SYSTEMATICS: Subgenus *Rabida*. In *N. furiosus* species group; most closely related to *N. munitus* (Taylor 1969).



TN: Lauderdale-Tipton Co., Hatchie River, 100 mm SL (R. T. Bryant, Jr.).



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Tributaries of Mississippi River in western MS and TN, north throughout much of Ohio River basin to northern IN and extreme western PA. Also in western Lake Erie drainage in OH, IN, and MI. Typically found in large creeks and small rivers with bottom usually of shifting sand and mud, and water varying from clear to turbid with moderate current. Avoids extremely silty situations. Little cover usually present aside from tree limbs and debris. Never very common.

ADULT SIZE: 37-100 mm SL.

BIOLOGY: Trautman (1957. *The Fishes of Ohio*; as *Noturus furiosus*) lists lengths of young of year, yearlings, and adults in OH. No data on food habits or reproduction, but presumably similar to other related species of *Noturus*.

Compiler: F. C. Rohde. February 1978.

Noturus taylori Douglas
Caddo madtom

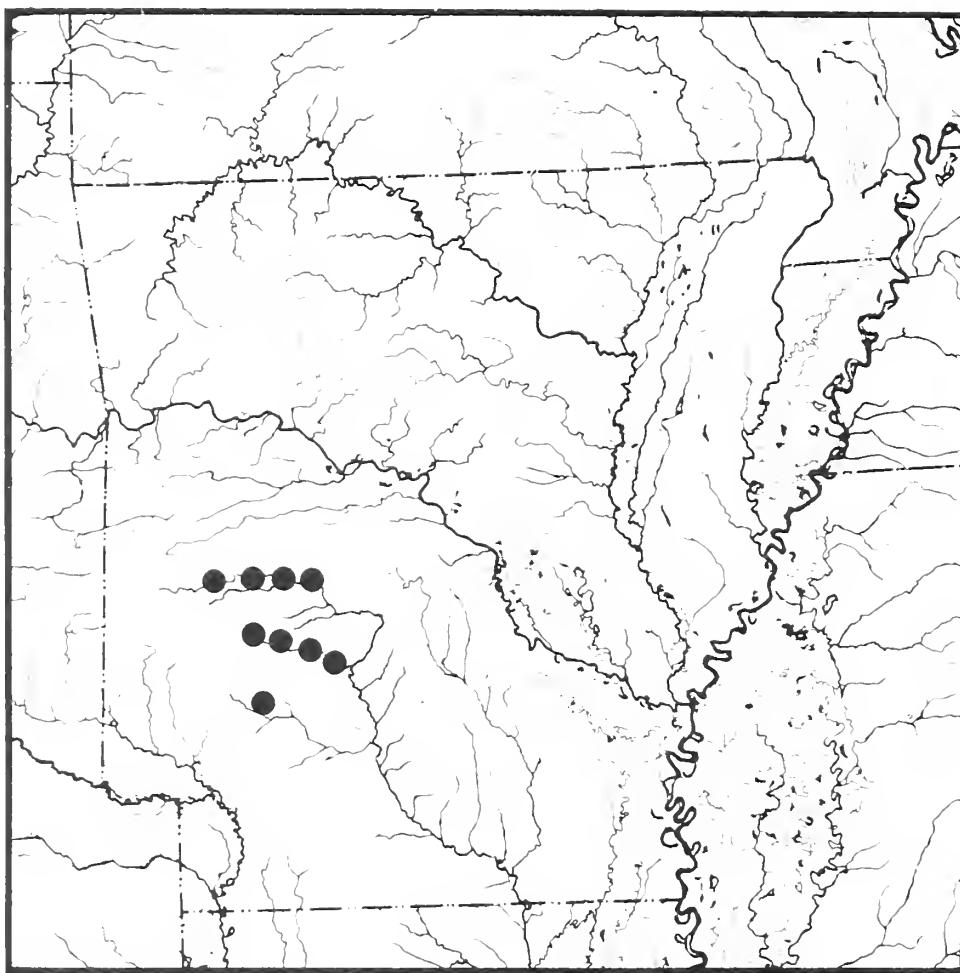
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: South fork of Caddo River, 1.6 km se of Hopper and 0.8 km s of AR hwy. 240, Montgomery Co., AR (Douglas 1972. Copeia:785-89).

SYSTEMATICS: Subgenus *Rabida*. Most closely related to *N. elegans* (Douglas 1972).



Holotype, male, 38 mm SL
(Douglas 1972).



DISTRIBUTION AND HABITAT: Occurs in clear shallow water over small rocks and gravel in shoals near shoreline in upper Caddo, Little Missouri, and Ouachita rivers.

BIOLOGY: No information on life history available. Robison (1974. Arkansas Acad. Sci. Proc. 28:62) and Buchanan (1974. in *Arkansas Natural Area Plan*) regard this species as endangered.

ADULT SIZE: 30-48 mm SL.

Compiler: H. W. Robison. May 1978.

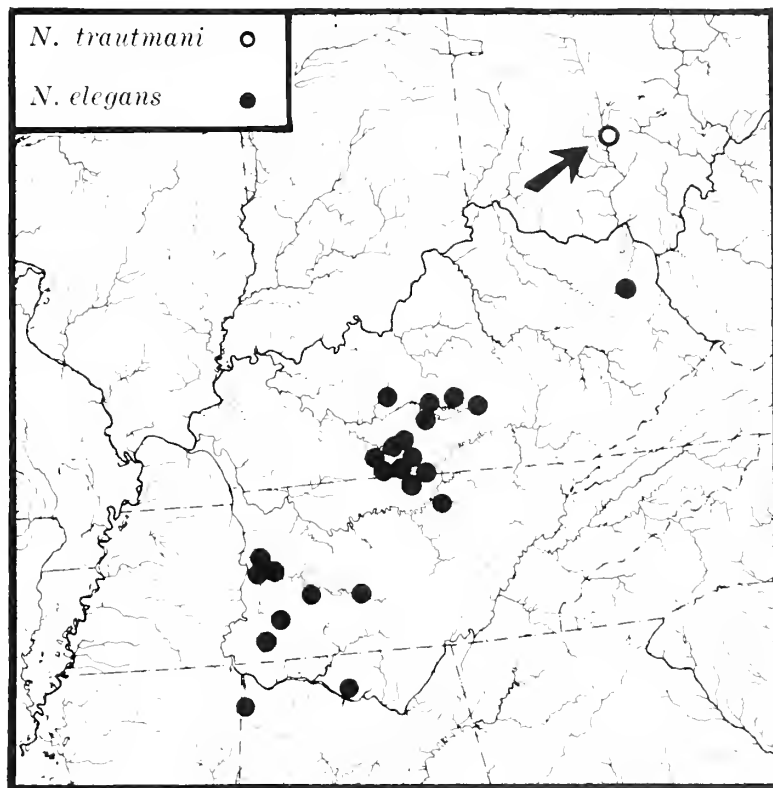
Noturus trautmani Taylor
Scioto madtom

Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Big Darby Creek, 1.6 km s of Fox, southeastern Jackson Township, Pickaway Co., OH (Taylor 1969. U. S. Natl. Mus. Bull. 282:1-315).

SYSTEMATICS: Subgenus *Rabida*. Most closely related to *N. elegans* (Taylor 1969).

(NCSM)



Map modified from Taylor 1969

DISTRIBUTION AND HABITAT: Known only from the type locality, a tributary of Scioto River. Taken in riffles with a bottom of gravel, sand, silt, and boulders. Some vegetation may be present and current is moderate to fast. Extremely rare. Although the Big Darby Creek ichthyofauna is one of the best known in OH, only 19 specimens were known at the time of original description.

ADULT SIZE: 23-41 mm SL.

BIOLOGY: Nothing known. Despite intensive year-around collecting efforts, specimens have only been taken during late fall and early winter.

Compiler: F. C. Rohde. May 1978.

Pylodictis olivaris (Rafinesque)
Flathead catfish

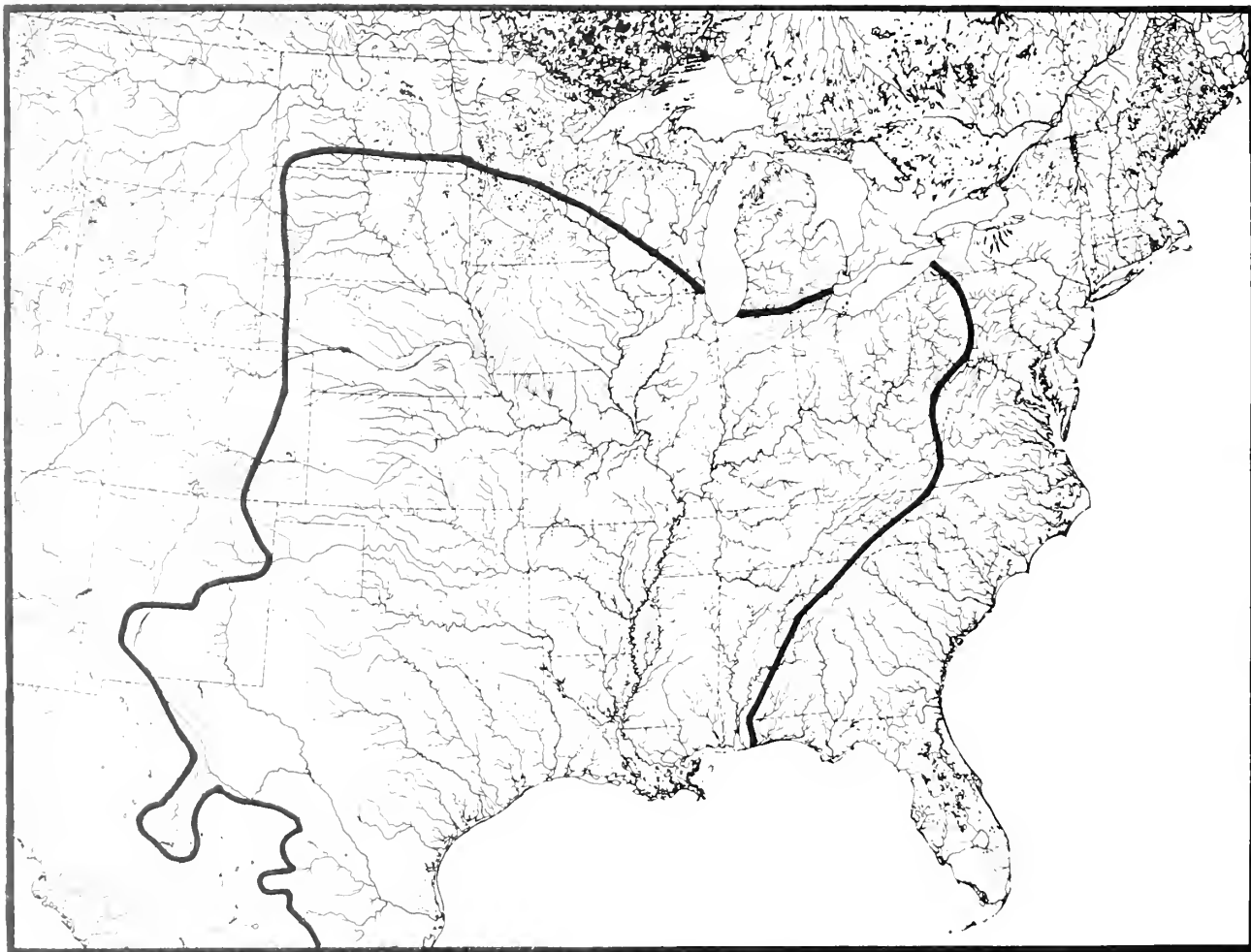
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: "Ohio River" (Rafinesque 1818. Am. Mon. Mag. Crit. Rev. 3: 354-56).

SYSTEMATICS: Monotypic genus. No definitive systematic study exists. Smith (1979. *The Fishes of Illinois*) commented on great individual, but only minimal geographic, variation of species. Phylogenetic relationships with other ictalurids presented by Taylor (1969. U.S. Natl. Mus. Bull. 282:1-315).



NC: Swain Co., Little
Tennessee River, 122 mm SL
(NCSM).



Line encloses native distribution

DISTRIBUTION AND HABITAT: Originally known from large rivers of Mississippi, Missouri, and Ohio basins and south into Mexico. Recently reported west of Point Pelee, ON (Crossman and Leach 1979. Can. Field-Nat. 93:179-80). Only sparingly introduced outside native range. Characteristic of deep holes of medium and large-sized rivers. Young sometimes in riffle areas of larger rivers (Smith 1979). Common.

ADULT SIZE: 1410 mm TL maximum.

BIOLOGY: Breder and Rosen (1966. *Modes of Reproduction in Fishes*) and Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) summarized information on reproduction and fishery. Smith (1979) reported sexual maturity reached in three to four years and may live to twenty years. Food primarily fish and crustaceans. Scott and Crossman (1973. *Freshwater Fishes of Canada*) mentioned occurrence of hybrids with *Ictalurus punctatus*.

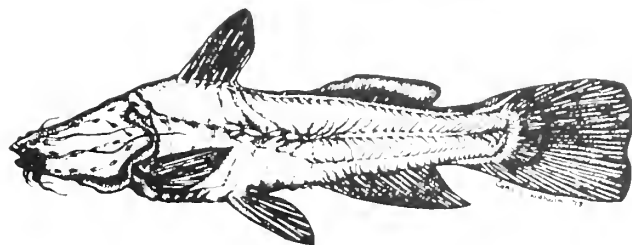
Compiler: G. S. Glodek. August 1979.

Satan eurystomus Hubbs and Bailey
Widemouth blindcat

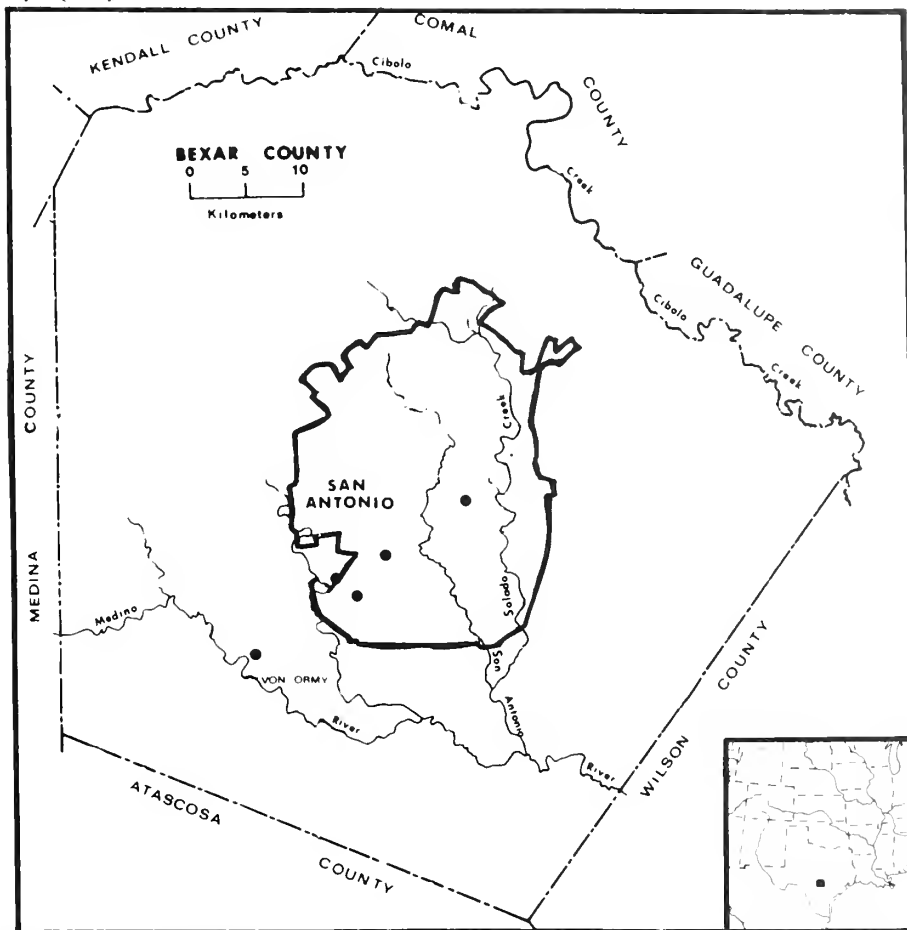
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Artesian well near San Antonio, Bexar Co., TX (Hubbs and Bailey 1947. Occas. Pap. Mus. Zool. Univ. Mich. 499:1-17).

SYSTEMATICS: Monotypic genus. Hubbs and Bailey (1947) concluded *Satan* and *Pylodictis* evolved from common ancestor; Suttkus (1961. Southwest Nat. 6:55-64) presented additional supportive evidence for this view; and Taylor (1969. U.S. Natl. Mus. Bull. 282: 1-315) provided phylogeny of Ictaluridae.



TX: Bexar Co., San Antonio
(Longley and Karnei 1979).



DISTRIBUTION AND HABITAT: All specimens from five artesian wells penetrating San Antonio Pool of Edwards Aquifer (Edwards Limestone, Lower Cretaceous) at depths of 305-582 m in and near San Antonio, Bexar Co., TX. Water temperature 27°C. Wells with 24°C water in north and north-western Bexar Co. have not produced species. Occurs in same artesian waters as *Trogloglanis pattersoni*, but only two (possibly three) wells produced both species. Apparently abundant (Longley and Karnei 1979. End. Species Rep. 5, Pt. 2, Spec. Publ. USFWS, Albuquerque, 48 pp.).

ADULT SIZE: 61-113 mm SL.

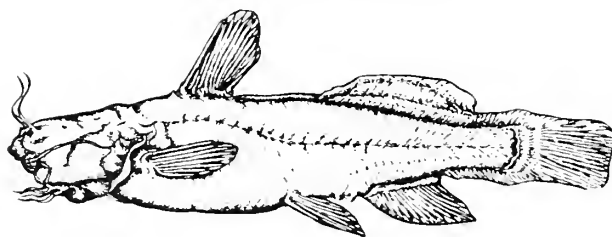
BIOLOGY: Hubbs and Bailey (1947) mentioned great hydrostatic pressure under which species, which lacks air bladder, lives. Eigenmann (1919. Proc. Am. Philos. Soc. 58:397-400) and Longley and Karnei (1979) indicated potential prey abundant in habitat; latter found remains of shrimp, amphipods and isopods in stomachs and also suggested possible predation on *T. pattersoni*. Suttkus (1961) reported newspaper account mentioning "several dozen fresh-water shrimp" from 427 m deep well with blind catfish in San Antonio in June 1960. Longley and Karnei (1979) provided the only recent information on all aspects of biology and habitat.

Compilers: J. E. Cooper and G. Longley,
June 1979.

Trogloglanis pattersoni Eigenmann
Toothless blindcat

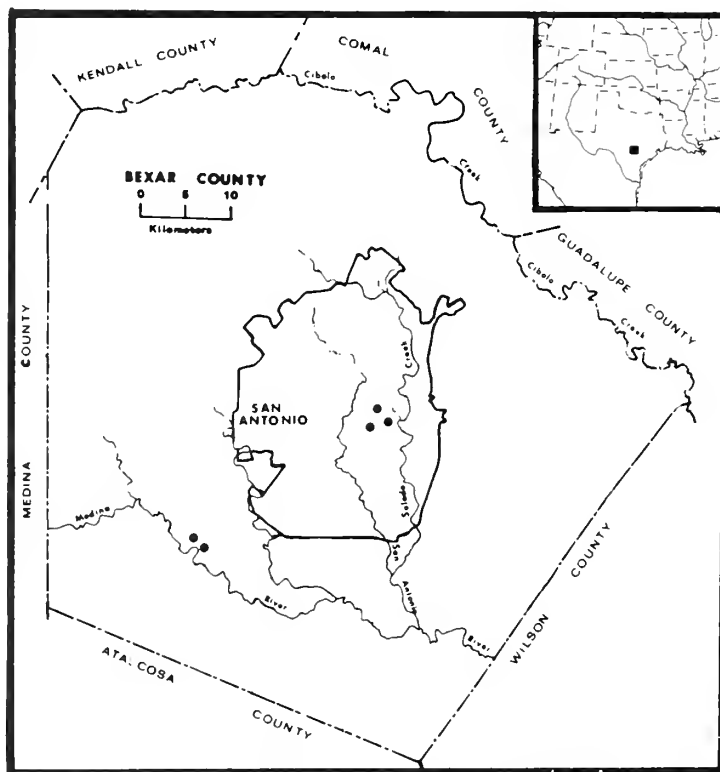
Order Siluriformes
Family Ictaluridae

TYPE LOCALITY: Artesian well, San Antonio, Bexar Co., TX (Eigenmann 1919. Proc. Am. Philos. Soc. 58:397-400).



TX: Bexar Co., San Antonio,
87 mm SL (Longley and Karnei
1979).

SYSTEMATICS: Monotypic genus. Eigenmann (1919) suggested derivation from *Schilbeodes* (= *Noturus*). Hubbs and Bailey (1947. Occas. Pap. Mus. Zool. Univ. Mich. 499:1-17) felt derivation from an *Ameirus* (= *Ictalurus*) type most plausible, but pointed out *Trogloglanis* most highly specialized genus of family. Suttkus (1961. Southwest. Nat. 6:55-64) said it resembled members of genus *Ictalurus*, especially *I. melas*, "in the shape of the dermethmoid." Taylor (1969. U.S. Natl. Mus. Bull. 282:1-315) provided phylogeny of Ictaluridae.



DISTRIBUTION AND HABITAT: All specimens from five artesian wells penetrating San Antonio Pool of Edwards Aquifer (Edwards Limestone, Lower Cretaceous) at depths of 305-582 m in and near San Antonio, Bexar Co., TX. Water temperature 27°C. Wells with 24°C water in north and northwestern Bexar Co. have not produced species. Occurs in same artesian waters as *Satan eurystomus*, but only two (possibly three) wells produced both species. Apparently abundant (Longley and Karnei 1979. End. Species Rep. 5, Pt. 1, Spec. Publ. USFWS, Albuquerque: 1-48).

ADULT SIZE: 50-87 mm SL.

BIOLOGY: Hubbs and Bailey (1947) mentioned great hydrostatic pressure under which species, which lacks air bladder, lives. Eigenmann (1919) and Longley and Karnei (1979) indicated potential food abundant in habitat; latter suggested feeding on fungal growths and dead or dying organisms in soft substrate, and felt species may be preyed on by *S. eurystomus*. Longley and Karnei (1979) provided the only recent information on all aspects of biology and habitat.

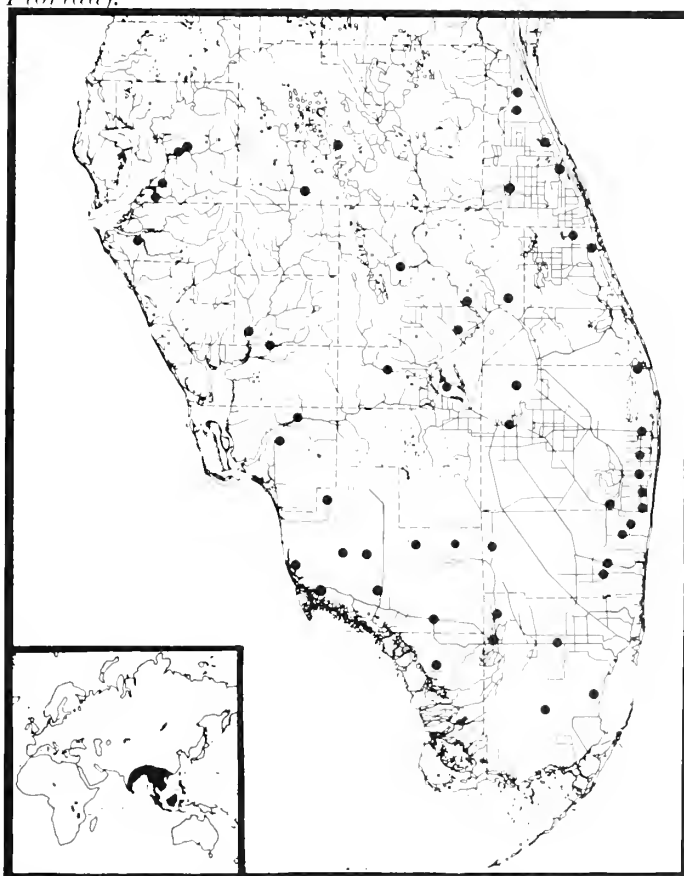
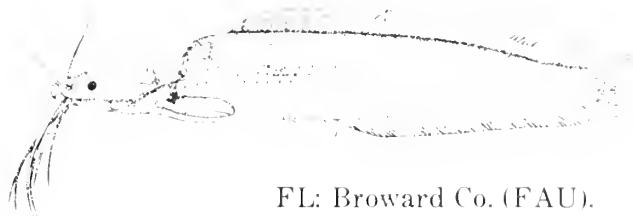
Compilers: J.E. Cooper and G. Longley. June 1979.

Clarias batrachus (Linnaeus)
Walking catfish

Order Siluriformes
Family Clariidae

TYPE LOCALITY: Asia and Africa; name later restricted to Asian species (Linnaeus 1758, *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Asian species in need of revision. Major references are those of Weber and De Beaufort (1913, *The Fishes of the Indo-Australian Archipelago II*), Hora (1936, Rec. Ind. Mus. Calcutta 38: 347-61), Fowler (1941, U.S. Natl. Mus. Bull. 100:1-879), and Smith (1945, U.S. Natl. Mus. Bull. 188:1-622). Morphology of three species compared by Arai and Hirano (1974, Jpn. J. Ichthyol. 21:53-60). Included in keys to fishes of AZ by Minckley (1973, *Fishes of Arizona*) and FL by Stevenson (1976, *Vertebrates of Florida*).



DISTRIBUTION AND HABITAT: Native distribution — From Sri Lanka through eastern India to the Malay Archipelago. Established in peninsular FL and has been collected in CA, NV, MA, and GA. Abundant at FL localities. Range in FL has expanded rapidly and it is a threat to many native species. Primarily found in slow streams, ponds, or lakes with muddy bottoms. Able to live in deoxygenated water and travel limited distances over land due to an accessory respiratory organ. Appears to have broad salinity tolerance. Introductions due to releases or escapes from fish farms and releases by aquarists.

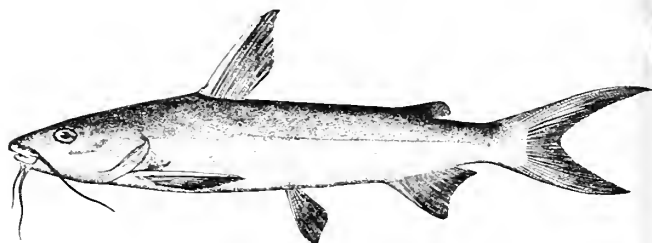
ADULT SIZE: In United States 225-300 mm SL, 550 mm SL maximum.

BIOLOGY: Omnivorous. Spawns during wet season. Adhesive eggs laid in a nest of submerged vegetation. Nest is guarded by male. Literature on reproduction summarized by Breder and Rosen (1966, *Modes of Reproduction in Fishes*). Synchronous aerial respiration discovered in FL population (Loftus 1979, *Copeia*:156-58).

Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Arius felis (Linnaeus)
Hardhead catfish

Order Siluriformes
Family Ariidae



FL: Pensacola (Jordan and
Evermann 1900).

TYPE LOCALITY: Charleston, SC (Linnaeus 1766. *Systema naturae*, Laurentii Salvii, Holmae, 12 ed., 1:1-532).

SYSTEMATICS: Only member of genus in United States. Miller (1966. *Copeia*: 795) synonymized *Galeichthys* with *Arius*. Hubbs (1936. *Publ. Carn. Inst. Wash.* 457:157-287) discussed nomenclatural changes and related problems. Listed by Taylor and Menezes (1977. *in* Fischer [ed.] 1978. *FAO Species Identification Sheets for Fishery Purposes — Western Central Atlantic (Fishing Area 31)*, Vol. I) as in genus *Ariopsis*.



DISTRIBUTION AND HABITAT: Along Atlantic Slope of North America from Cape Cod south to Yucatan, Mexico. Briggs (1958. *Bull. Fla. State Mus. Biol. Sci.* 2:223-318) reported occurrence to Panama but this apparently an error (Taylor *in* Jones et al. 1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 1). Enters fresh water. Common in salinities up to 45 ppt., but occasionally taken in water up to 60 ppt. Found in turbid, shallow, coastal waters with sand or mud substrates. Occasionally enters rivers in southern portion of range. Known to school (Gunter 1939. *Ecol. Monogr.* 8:313-46). May migrate into deeper water in winter (Dahlberg 1975. *Guide to Coastal Fishes of Georgia and Nearby States*).

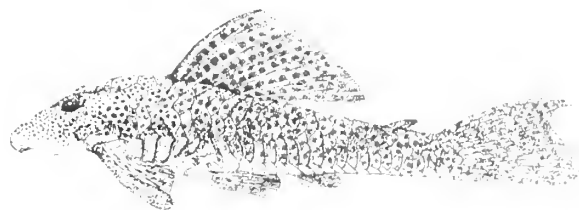
ADULT SIZE: 120 mm TL.

BIOLOGY: Mouth brooder, spawns in the summer in shallow waters of back bays of Gulf of Mexico (Lee 1937. *Copeia*: 49-56). Larvae remain in mouth of male 2-4 weeks after hatching. Opportunistic bottom feeder preying primarily on worms and small crustaceans. Eaten by *Lepisosteus osseus* (Suttkus 1963. *Order Lepisosteus in Mem. Sears Found. Mar. Res.* 1[3]:61-88).

Compilers: S. P. Platania and S. W. Ross.
March 1979.

Hypostomus spp.
Armored catfishes

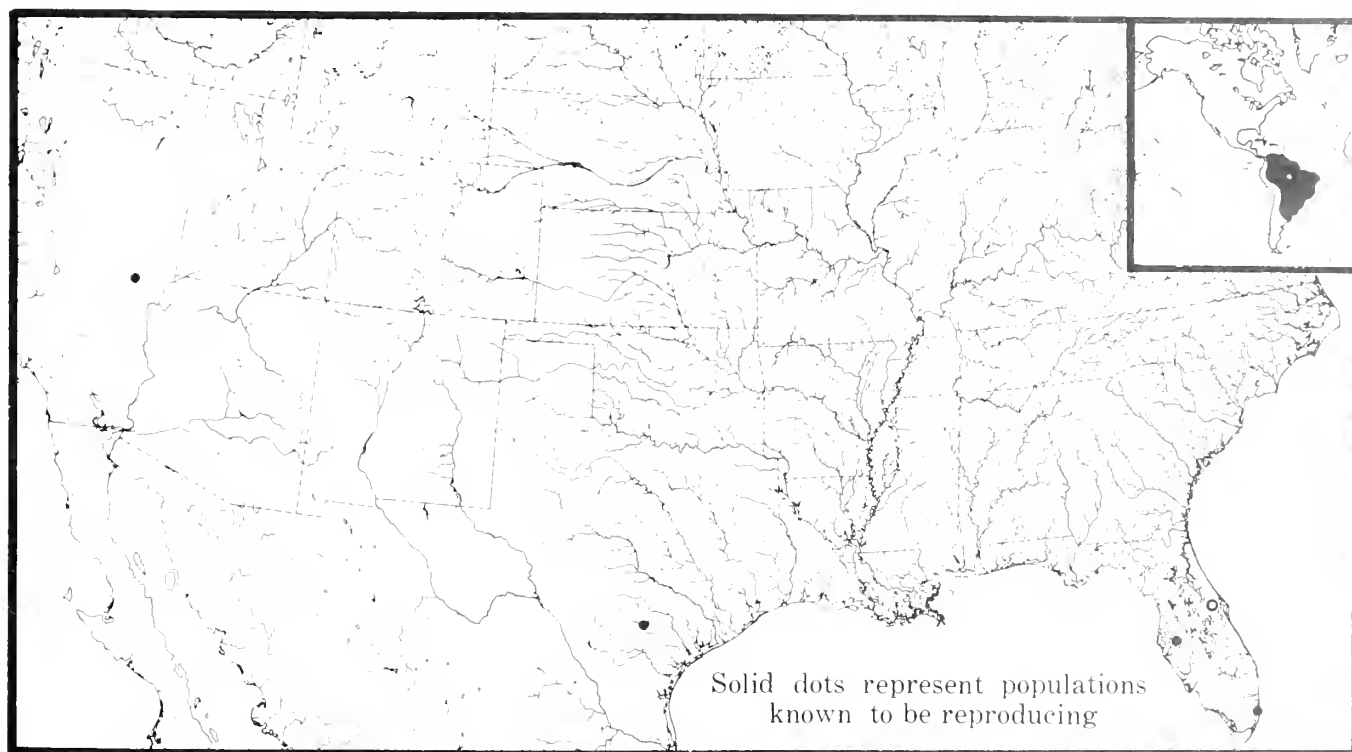
Order Siluriformes
Family Loricariidae



TYPE LOCALITY: Of type species (*H. plecostomus*), Surinam River outlet, Surinam (Boeseman, Zool. Verhand., Leiden 99:1-89).

SYSTEMATICS: Major references on systematics of genus are Regan (1904, Trans. Zool. Soc. Lond 17:191-350), Gosline (1947, Arq. Mus. Nac., Rio de Janeiro 41:79-134), and Boeseman (1968). Number and identities of species established in United States uncertain. Included in key to FL freshwater fishes by Stevenson (1976, *Vertebrates of Florida*).

FL: Hillsborough Co. (FAU).



DISTRIBUTION AND HABITAT: Native distribution (genus) — Lakes, streams, and rivers from Rio de la Plata to eastern Ecuador and Costa Rica. Able to live in deoxygenated water and possibly make short migrations over land due to accessory respiratory organ (stomach). Established in NV, TX, and FL. Abundant at most United States localities. Adults found primarily in rocky habitats and juveniles in areas with heavy vegetation. Introductions into United States due to releases of home aquarium fish and in one case, stocking for control of algae.

ADULT SIZE: In FL 176-415 mm SL, 600 mm SL maximum.

BIOLOGY: Are mainly algal grazers; nocturnal feeders. Eggs laid in holes and guarded by parents. Summary of information on biology presented by Breder and Rosen (1966, *Modes of Reproduction in Fishes*) and Lowe-McConnell (1975, *Fish Communities in Tropical Freshwaters*).

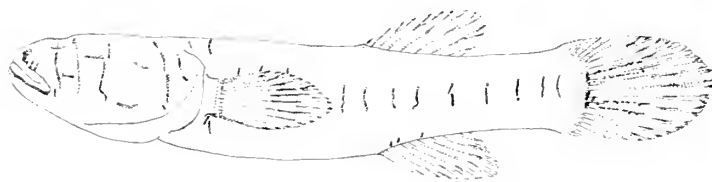
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

***Amblyopsis rosae* (Eigenmann)**
Ozark cavefish

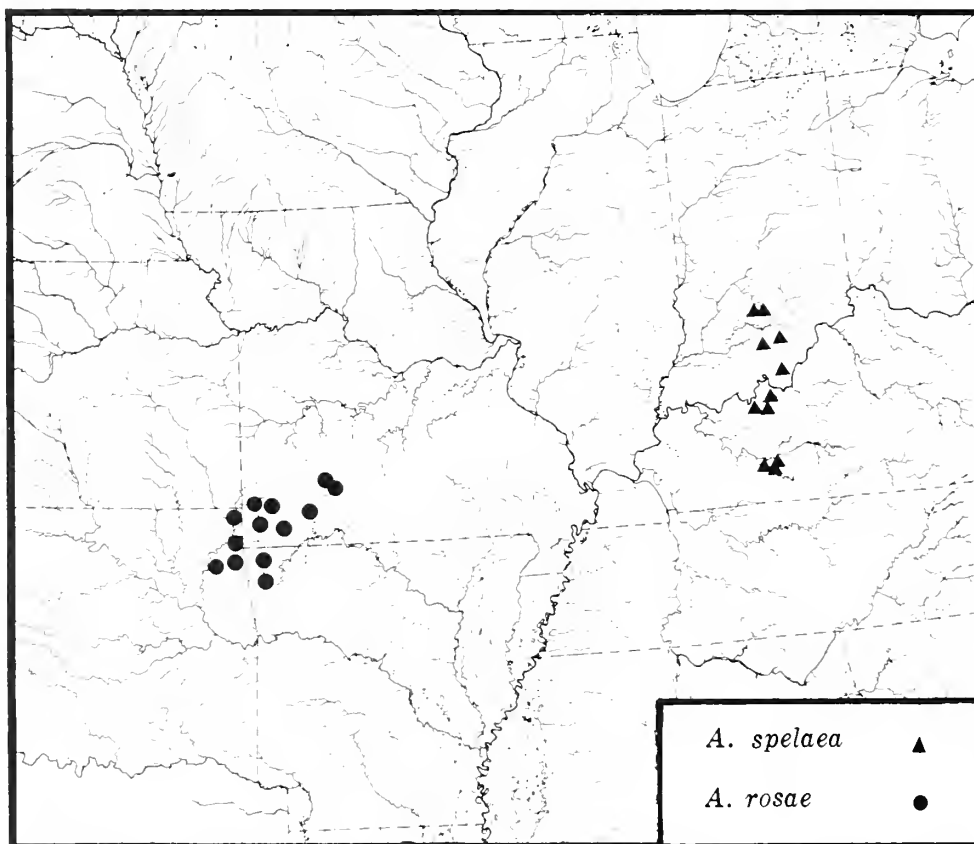
Order Percopsiformes
 Family Amblyopsidae

TYPE LOCALITY: "the caves of Missouri" (Eigenmann 1898, Proc. Indiana Acad. Sci. [1897]:231; as *Typhlichthys rosae*). Cox, who worked under Eigenmann, reported type locality as "Sarcoxie, Mo.," and indicated type specimens of "*Troglichthys*" (sic) *rosae* from Day's Cave (1905, Appen. Rep. Comm. Fish. [1904] Bur. Fish.:391-92).

SYSTEMATICS: One other species, *A. spelaea*, in genus. Eigenmann (1899, Science N.S. IX:280-82; indicated as Arch. Entwickelungsmech. Org. 8:545-617 by Woods and Inger 1957, Am. Midl. Nat. 58:232-56) erected genus *Troglichthys* for the species, and Cox (1905) retained. Woods and Inger (1957), in treatment of family, placed *T. rosae* in *Amblyopsis*. Rosen (1962, Am. Mus. Novit. 2109:1-35), Gosline (1963, Occas. Pap. Mus. Zool. Univ. Mich. 629:1-38), and Greenwood et al. (1966, Bull. Am. Mus. Nat. Hist. 131:341-55) discussed higher relationships of family.



ca. 47 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Subterranean waters of Ozark Uplift (Springfield Plateau) in southwest MO, northwest AR, and northeast OK. Primarily in clear streams, some of which experience scouring spates.

ADULT SIZE: 36-52 mm SL.

BIOLOGY: A highly cave-adapted species with small populations, depressed rate of increase (r), and low reproductive capacity. Poulson (1963, Am. Midl. Nat. 70:257-90; in Dill [ed.] 1964, *Handbook of Physiology* 4:749-71) discussed these and other aspects of biology.

Compiler: J. E. Cooper, July 1978.

Amblyopsis spelaea DeKay
Northern cavefish

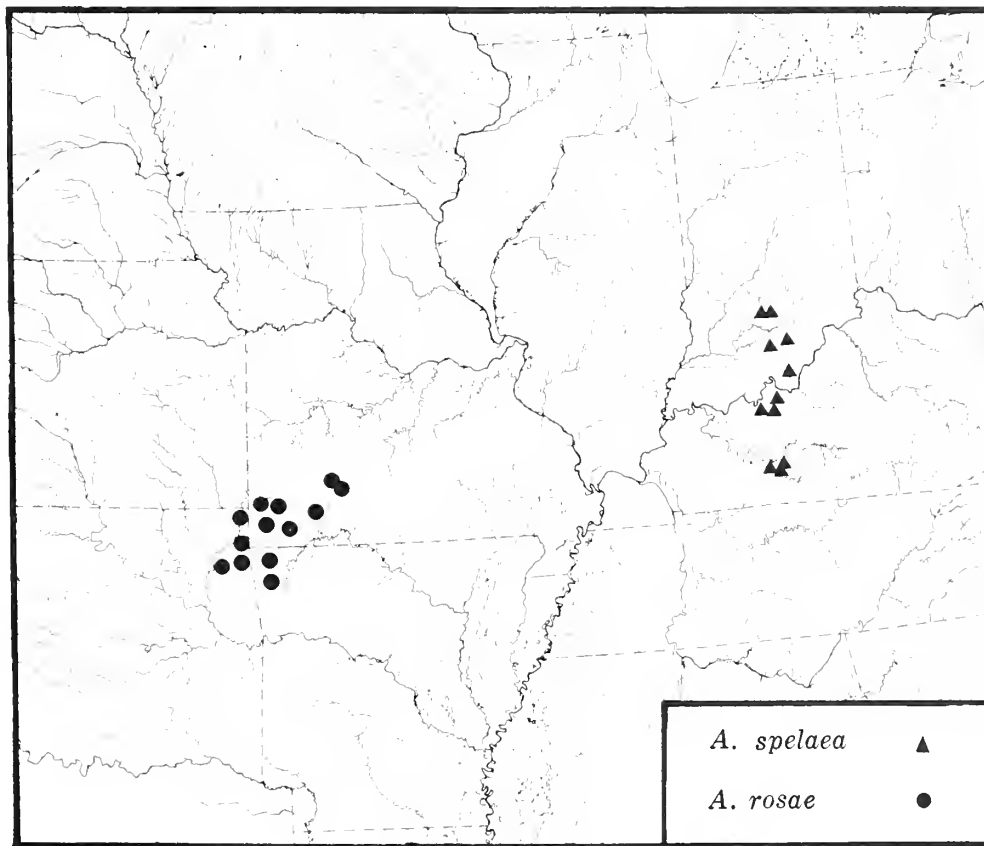
Order Percopsiformes
Family Amblyopsidae

TYPE LOCALITY: Mammoth Cave, Edmonson Co., KY (DeKay 1842. *Natural History of New York*. I. Zoology, 4. Fishes).

SYSTEMATICS: One other species, *A. rosae*, in genus. Woods and Inger (1957. *Am. Midl. Nat.* 58:232-56) provided most recent treatment of the family. Rosen (1962. *Am. Mus. Novit.* 2109:1-35), Gosline (1963. *Occas. Pap. Mus. Zool. Univ. Mich.* 629:1-38), and Greenwood et al. (1966. *Bull. Am. Mus. Nat. Hist.* 131:341-455) discussed higher relationships of family.



KY: Mammoth Cave, ca. 81 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Subterranean waters of Pennyroyal and Mitchell plateaus, from Mammoth Cave area, KY, north into southern IN. Sympatric with *Typhlichthys subterraneus* and *Chologaster agassizi* in Mammoth Cave. Barr (1967. *Int. J. Speleol.* III:147-204) and Barr and Kuehne (1971. *Ann. Speleol.* 26:47-96) discussed this system in detail. All populations are small.

BIOLOGY: Rate of increase (r) and reproductive capacity are very low. The species is a branchial brooder. Poulson (1963. *Am. Midl. Nat.* 70:257-90; in Dill [ed.] 1964. *Handbook of Physiology* 4:749-71), Barr (1967), and Barr and Kuehne (1971) discussed these and other aspects of biology. Putnam (1872. *Am. Nat.* 6:6-31) recorded one instance of predation on an eyed fish in Mammoth Cave. Nickol and Whittaker (1978. *Proc. Helminthol. Soc. Wash.* 45:136-37) reported acanthocephalan parasites from one specimen.

ADULT SIZE: ca. 45-85 mm SL.

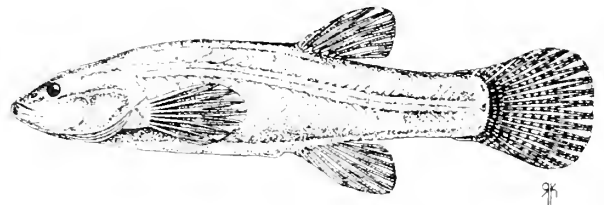
Compiler: J. E. Cooper. March 1979.

***Chologaster agassizi* Putnam**
Spring cavefish

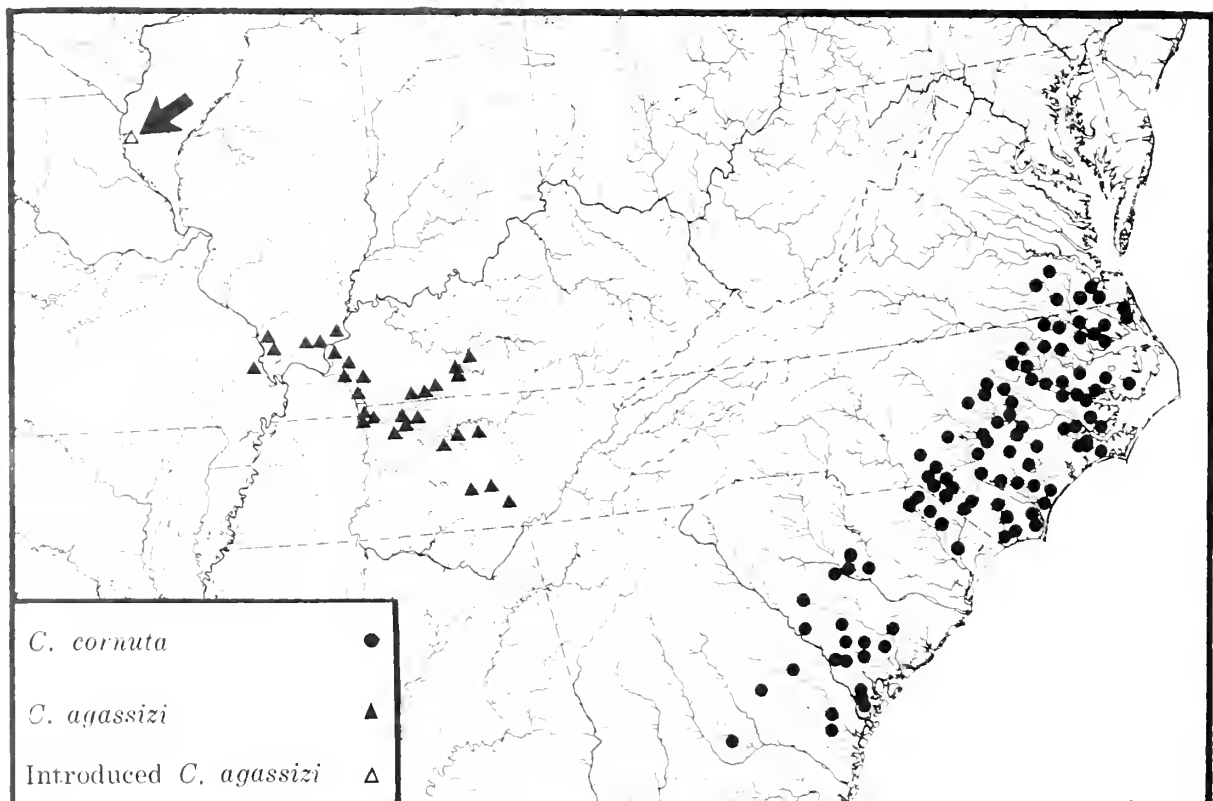
Order Percopsiformes
Family Amblyopsidae

TYPE LOCALITY: A well in Lebanon, Wilson Co., TN (Putnam 1872. Am. Nat. 6:6-30).

SYSTEMATICS: One other recognized member of genus, *C. cornuta*. Woods and Inger (1957. Am. Midl. Nat. 58:232-56) synonymized *Forbesichthys* (*Forbesella*) and *C. papilliferus* in their treatment of the family. Clay (1975. *The Fishes of Kentucky*) considered the latter species valid. Rosen (1962. Am. Mus. Novit. 2109:1-35), Gosline (1963. Occas. Pap. Mus. Zool. Univ. Mich. 629:1-38), and Greenwood et al. (1966. Bull. Am. Mus. Nat. Hist. 131:341-455) discussed higher relationships of family.



KY: Warren Co., Barren River, 26 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Springs and caves, from southcentral TN through southcentral and western KY to southern IL. Single locality west of Mississippi River in southeast MO (Pflieger 1975. *The Fishes of Missouri*). Weise (1957. Ecology 38:195-204) discussed habitat, and apparently unsuccessful transplant of 36 specimens to a cave-spring in Adams Co., IL. Most populations small to medium-sized, but at least one very large (Smith and Welch 1978. Ill. Nat. Hist. Surv. Biol. Notes 104:1-8).

BIOLOGY: Spawning probably occurs underground in late winter and/or early spring. Poulson (1963. Am. Midl. Nat. 70:257-90), Layne and Thompson (1952. Copeia:39-40), Gunning and Lewis (1955. Ecology 4:552-58), Weise (1957), Hill (1969. Am. Midl. Nat. 82:110-16; 1971. Proc. Okla. Acad. Sci. 51:13-14), and Smith and Welch (1978) discussed various aspects of biology. Parasites reported by Mizelle et al. (1969. Am. Midl. Nat. 82:298-302) and Whittaker and Hill (1968. Proc. Helminthol. Soc. Wash. 35:15-18).

ADULT SIZE: 35-70 mm SL.

Compiler: J. E. Cooper. March 1979.

***Chologaster cornuta* Agassiz**
Swampfish

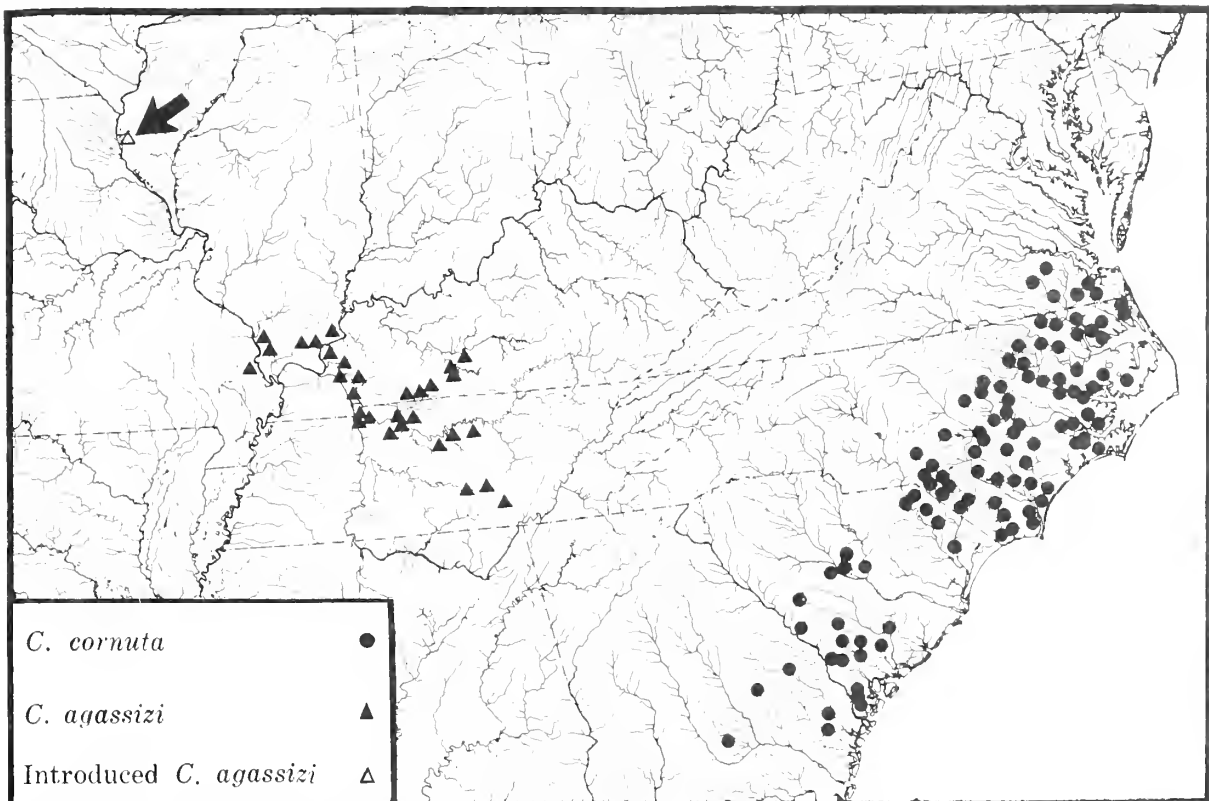
Order Percopsiformes
Family Amblyopsidae

TYPE LOCALITY: "ditches of the rice fields in South Carolina" (Agassiz 1853. Am. J. Sci. Arts 16:134-36). Putnam (1872. Am. Nat. 6:6-30) indicated that three specimens in the Museum of Comparative Zoology, "labelled as the originals of *Chologaster cornuta*" were from "Waccamaw, S. C."

SYSTEMATICS: One other recognized member of the genus, *C. agassizi*, Jordan and Evermann (1896. Bull. U.S. Natl. Mus. 47:1 1240) considered *C. aritus* a color variant of *C. cornuta*. Woods and Inger (1957. Am. Midl. Nat. 58:232-56) reviewed the family Amblyopsidae. Rosen (1962. Am. Mus. Novit. 2109:1-35), Gosline (1963. Occas. Pap. Mus. Zool. Univ. Mich. 629:1-38), and Greenwood et al. (1966. Bull. Am. Mus. Nat. Hist. 131:341-455) discussed higher relationships of family.



VA: Dismal Swamp (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Cryptic habitats in swamps, ponds, ditches, and slow-moving streams in Atlantic Coastal Plain, from southeast VA to east-central GA. Although frequently encountered and often abundant, it is not very well represented in collections.

ADULT SIZE: 23-57 mm SL.

BIOLOGY: Spawning occurs in March and April. Poulson (1961. Ph.D. diss., Univ. Michigan) found a mean of 98 eggs per female.

The method of spawning is not known. Maximum age appears to be 1+ years. Dominant food items are amphipods, ostracods, and copepods. Poulson (1961; 1963. Am. Midl. Nat. 70:257-90) discussed various aspects of biology, and Mizelle et al. (1969. Am. Midl. Nat. 82:298-302) described a monogenetic trematode which occurs on its external surface.

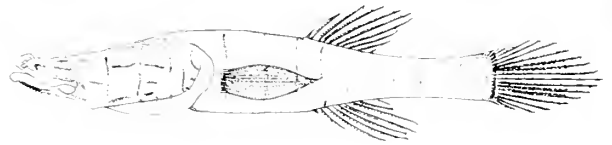
Compilers: J. E. Cooper and F. C. Rohde.
July 1978.

Speoplatyrhinus poulsoni Cooper
and Kuehne
Alabama cavefish

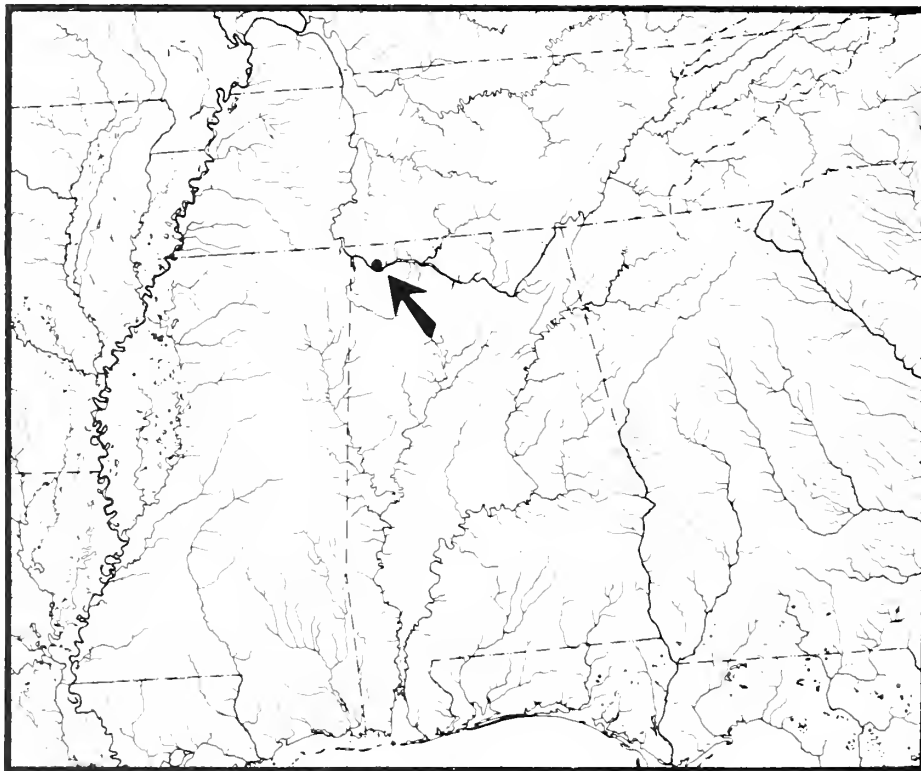
Order Percopsiformes
Family Amblyopsidae

TYPE LOCALITY: Key Cave, Lauderdale Co., AL (Cooper and Kuehne 1974. Copeia: 486-93).

SYSTEMATICS: Monotypic genus. Cooper and Kuehne (1974) briefly discussed allocation to family Amblyopsidae.



AL: Lauderdale Co., Key Cave
(NCSM).



DISTRIBUTION AND HABITAT: Known only from lentic subterranean waters at type locality in north bank of Tennessee River west of Florence, AL, near southeastern edge of Highland Rim. Cooper and Kuehne (1974) described habitat. Undoubtedly one of rarest freshwater fishes in the world, known from only nine specimens. Considered a Threatened species in USFWS listings.

ADULT SIZE: 31.2-58.3 mm SL (type series) ; larger specimens seen but not collected.

BIOLOGY: Very little information available. Population very small and, as the most cave-adapted amblyopsid known, species undoubtedly has greatly depressed rate of increase (r) and very low reproductive capacity. Probably a branchial brooder. Cooper and Kuehne (1974) discussed associates and potential trophic sources.

Compiler: J. E. Cooper. May 1978.

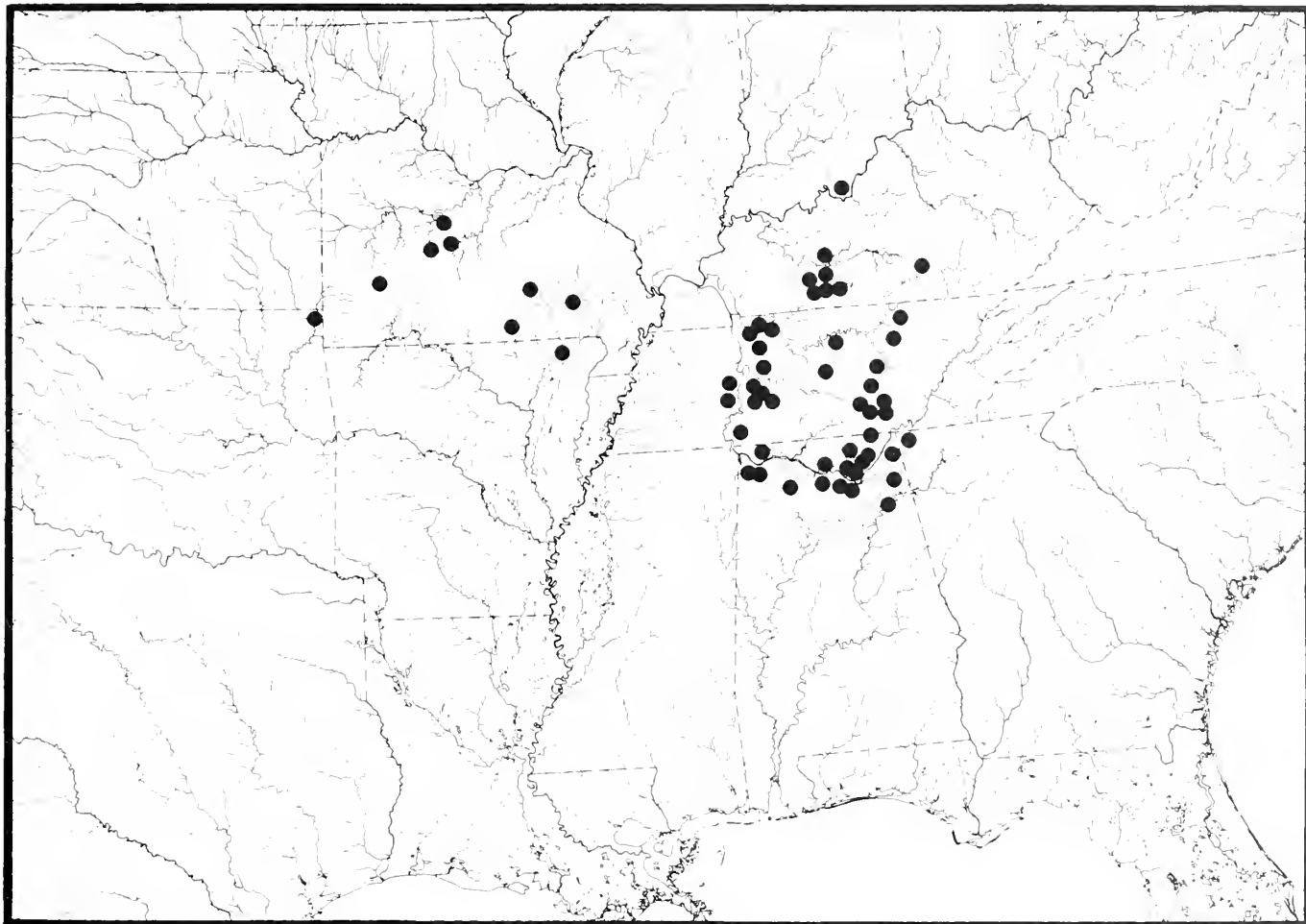
Typhlichthys subterraneus Girard
Southern cavefish

Order Percopsiformes
Family Amblyopsidae

TYPE LOCALITY: Well near Bowling Green, Warren Co., KY (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:56-68).

SYSTEMATICS: Monotypic genus. Two nominal forms, *T. osborni* and *T. wyandotte*, synonymized by Woods and Inger (1957. Am. Midl. Nat. 58:232-56) in treatment of family. Poulson (1961. Ph.D. diss., Univ. Michigan.) studied variation in several populations. Rosen (1962. Am. Mus. Novit 2109:1-35), Gosline (1963. Occas. Pap. Mus. Zool. Univ. Mich. 629:1-38), and Greenwood et al. (1966. Bull. Am. Mus. Nat. Hist. 131:341-455) discussed higher relationships of family.

AL: DeKalb Co., Sell's Cave,
4.8 km s of Collinsville, 28 mm
SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Subterranean waters in two major disjunct ranges: Ozark Plateau of southern MO, northeast AR, and northeast OK (questionable); and Cumberland and Interior Low plateaus of northern AL, northwest GA, central TN and KY, and southern IN. Essentially lentic but also in pools of streams at or near water table. Populations small.

ADULT SIZE: 35-65 mm SL.

BIOLOGY: Rate of increase (r) and reproductive capacity low. Poulson (1963. Am. Midl. Nat. 70:257-90; in Dill [ed.] 1964. *Handbook of Physiology* 4:749-71) discussed these and other aspects of biology. Cooper and Iles (1971. Natl. Speleol. Soc. Bull. 33: 45-49) and Cooper and Beiter (1972. Copeia: 879-81) mentioned ecological associates and prey.

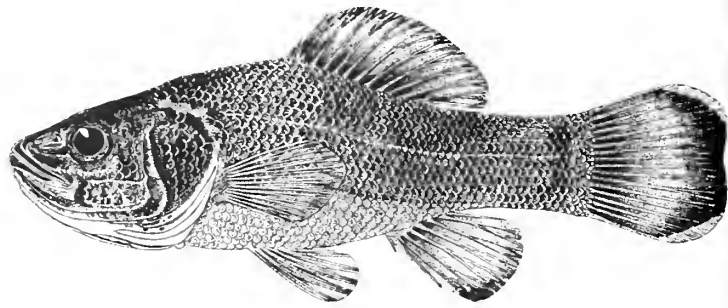
Compiler: J. E. Cooper. May 1978.

Aphredoderus sayanus (Gilliams)
Pirate perch

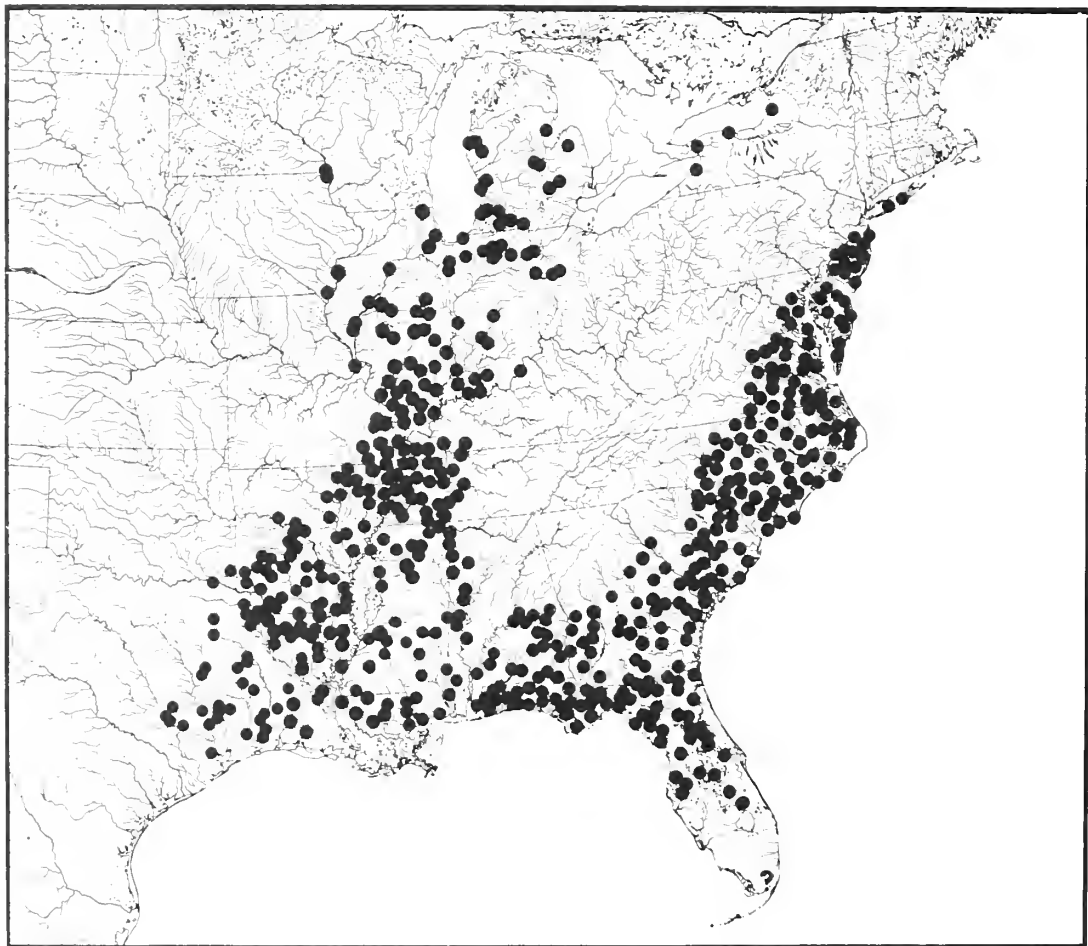
Order Percopsiformes
Family Aphredoderidae

TYPE LOCALITY: Fishponds, Harrowgate, "near Philadelphia" (Gilliams 1824. J. Acad. Nat. Sci. Phila. 4:80-82).

SYSTEMATICS: Only living member of family. Two recognized subspecies *A. s. sayanus* on Atlantic slope and *A. s. gibbosus* in west. Precise range limits of subspecies and zone of intergradation not recorded in literature, but presumed to be similar to that shown by Crossman (1966. Copeia: 1-20) for *Esox americanus*.



DE: Sussex Co., Raccoon Pond,
69 mm SL. (NCSM)



DISTRIBUTION AND HABITAT: Wide-spread throughout lowlands of Atlantic and Gulf slope, Mississippi Valley. Disjunct populations in Lake Erie and Lake Ontario drainages, western NY. In lakes, ponds, quiet pools, and backwaters of low gradient streams with an abundance of aquatic plants, organic debris and other cover. Rare and localized toward periphery of range (particularly in north), but elsewhere may be very common in preferred habitat.

ADULT SIZE: 64-144 mm TL.

BIOLOGY: Little is known. Recent summary by Pflieger (1975. *The Fishes of Missouri*) provided observations on age and growth. Early growth and development described by Mansueti (1963. Copeia:546-57). Huish and Shepherd (1975. J. Elisha Mitchell Sci. Soc. 91:76) investigated age, movement, density, period of fecundity, and stomach contents of a NC population. Insects are the major food (Becker 1923. Occas. Pap. Mus. Zool. Univ. Mich. 138:1-4; Flemer and Woolcott 1966. Chesapeake Sci. 7:75-89).

Compiler: D. S. Lee, April 1978.

Percopsis omiscomaycus (Walbaum)
Trout-perch

Order Percopsiformes
Family Percopsidae

TYPE LOCALITY: Hudson Bay (Walbaum in Artedi 1792, *Genera Piscium* 3:4-723).

SYSTEMATICS: This species and *P. transmontana* (endemic to the Columbia River drainage) comprise only two living species in the family. No systematic review of either has been published.

MD: C & O Canal, Buzzards Hole, 93 mm SL (NCSM).



DISTRIBUTION AND HABITAT: From central Atlantic slope (Potomac and Delaware drainages), north to QU, west to Ohio and lower Missouri River basin, and north to MacKenzie and Yukon drainages of northern Canada and AK, respectively. Typically inhabits lakes, but also occupies rivers and streams. Apparently extirpated from Potomac drainage. May be relatively common in lakes and rivers in more northern parts of range.

ADULT SIZE: 75-100 mm TL, 152 mm TL maximum.

BIOLOGY: Studies available in Adams and Hankinson (1928, Roosevelt Wild Life Ann. 1:235-548), Kinney (1950, M. Sc. thesis, Ohio State Univ.), Lawler (1954, J. Fish. Res. Board Can. 11:1-4), Magnuson and Smith (1963, Ecology 44:83-95), and Scott and Crossman (1973, *Freshwater Fishes of Canada*). Normally in deep waters during day, moving to shallow water at night to forage on insects and other invertebrates. Spawns May-June in NY, usually in streams with gravel or rocky bottom.

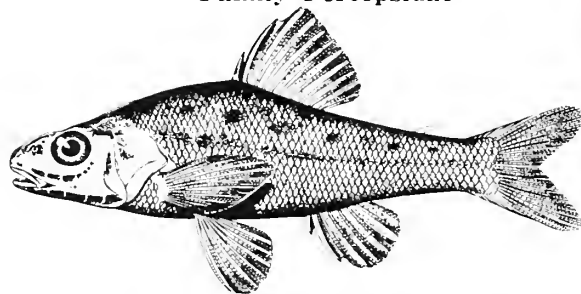
Compilers: C. R. Gilbert and D. S. Lee.
February 1978.

Percopsis transmontana
(Eigenmann and Eigenmann)
Sand roller

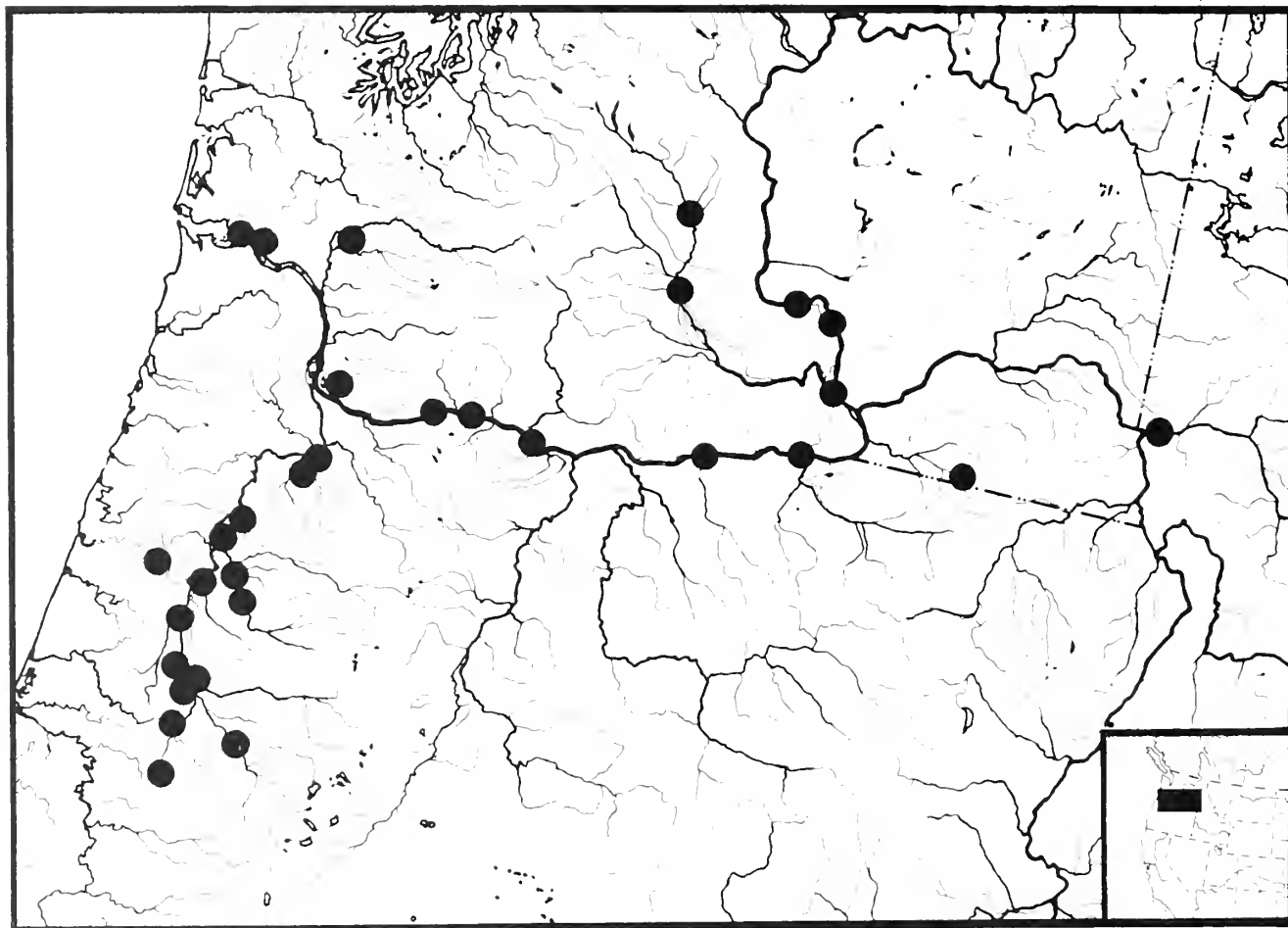
Order Percopsiformes
Family Percopsidae

TYPE LOCALITY: Umatilla River near mouth, Umatilla Co., OR (Eigenmann and Eigenmann 1892. Science 20:233-34).

SYSTEMATICS: Originally described and long recognized in genus *Columbia* which has been merged with *Percopsis* (Bailey et al. 1960. Am. Fish. Soc. Spec. Publ. 2:1-102).



OR: Mouth of the Umatilla River, ca. 61 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Uncommon inhabitant of Columbia River drainage and tributaries downstream from the mouth of Clearwater River, Nez Perce Co., ID (Pratt and Whitt 1952. Copeia: 267-68; Gray and Dauble 1979. Trans. Am. Fish. Soc. 108:646-49). Downstream limit is about 10 km above mouth of Columbia River (Reimers 1963. Res. Breifs Fish. Comm. Or. 9:64). Usually inhabits slow moving portions of streams and rivers with mud-sand bottom (Eigenmann and Eigenmann 1892; Gilbert and Evermann 1895. Bull. U.S. Fish. Comm. [1894]: 169-201; Gray and Dauble 1976. Syesis 9:369-70), often near undercut banks (Reimers and Bond 1967. Copeia: 541-50). Also been

captured over a rubble substrate with considerable aquatic vegetation and recently over rock and sand substrate to depths of 3 m (Gray and Dauble 1979).

ADULT SIZE: 60-80 mm SL.

BIOLOGY: One female contained 5370 eggs (Rulifson 1948. unpubl. rept.). Simpson and Wallace (*Fishes of Idaho*, in press) noted age and time of spawning and importance in ID. and Gray and Dauble (1976; 1979) reported age and growth, reproduction, and feeding from populations in the Hanford reach of the Columbia River.

Compiler: R. L. Wallace, February 1979.

Lota lota (Linnaeus)
Burbot

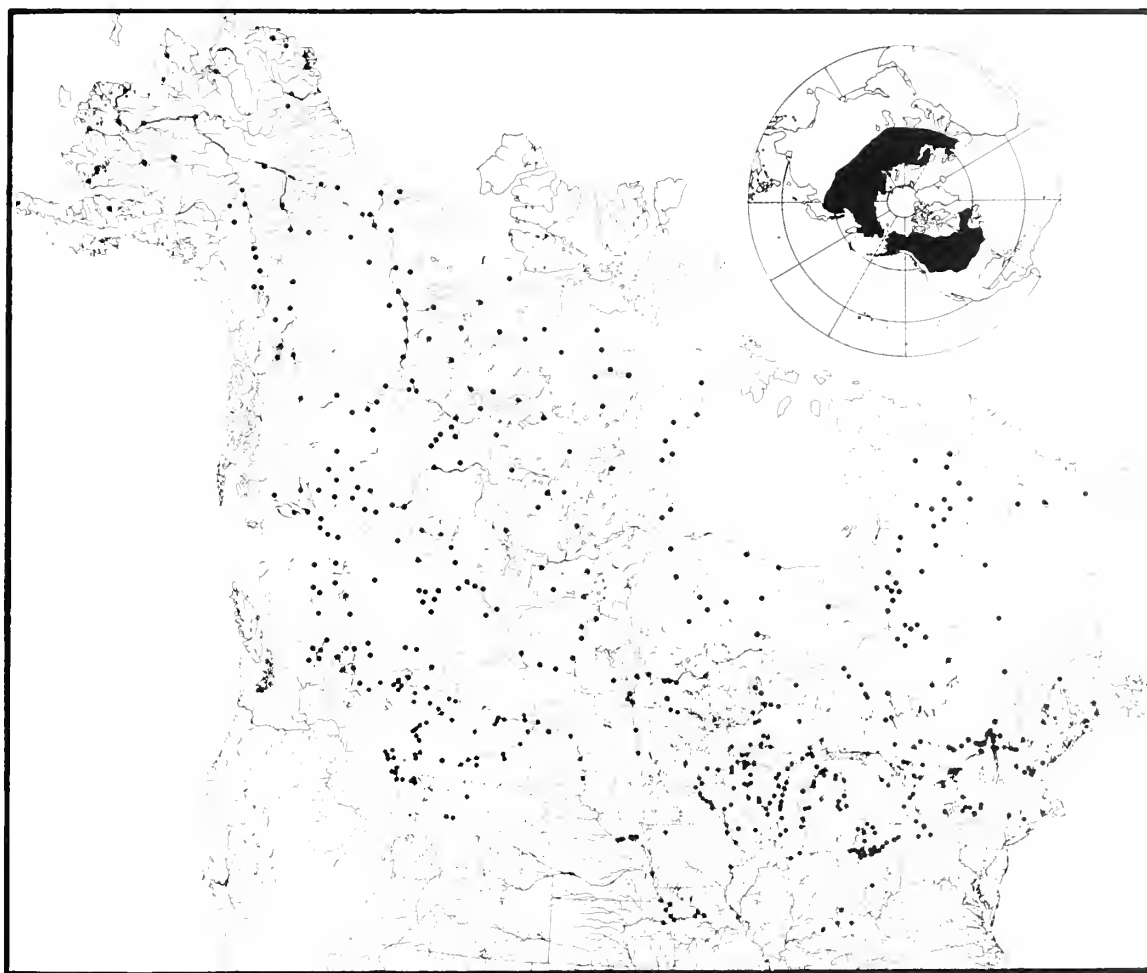
Order Gadiformes
Family Gadidae

TYPE LOCALITY: "Europe" (Linnaeus 1758, *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824.)

SYSTEMATICS: Evidence of clinal variation (McPhail and Lindsey 1970, *Freshwater Fishes of Northwestern Canada and Alaska*) suggested that earlier recognition of subspecies unwarranted (Scott and Crossman 1973, *Freshwater Fishes of Canada*).



YU: Big Joe Creek, 255 mm
SL (NMC).



DISTRIBUTION AND HABITAT: Widely distributed in both hemispheres south to about 40°N. Absent from most islands, west coast of Norway, Kamchatka Peninsula (USSR), NS, and extreme western BC. Common in deep (up to 213m) cold waters of lakes, reservoirs, and rivers. Often moves into tributaries in late winter and early spring. Enters brackish waters. Records from southern portion of range may represent vagrant individuals and not established populations.

ADULT SIZE: 343-837 mm TL.

BIOLOGY: Much published information, summarized by Scott and Crossman (1973) and Carlander (1969, *Handbook of Freshwater Fishery Biology* Vol. 1). Spawning takes place in winter, peaking in early February. Nocturnal. Young feed on immature aquatic insects, crayfish, and occasionally fish. Individuals over 500 mm TL feed almost exclusively on fish.

Compilers: D. S. Lee and C. R. Gilbert.
September 1978.

Microgadus tomcod (Walbaum)
Atlantic tomcod

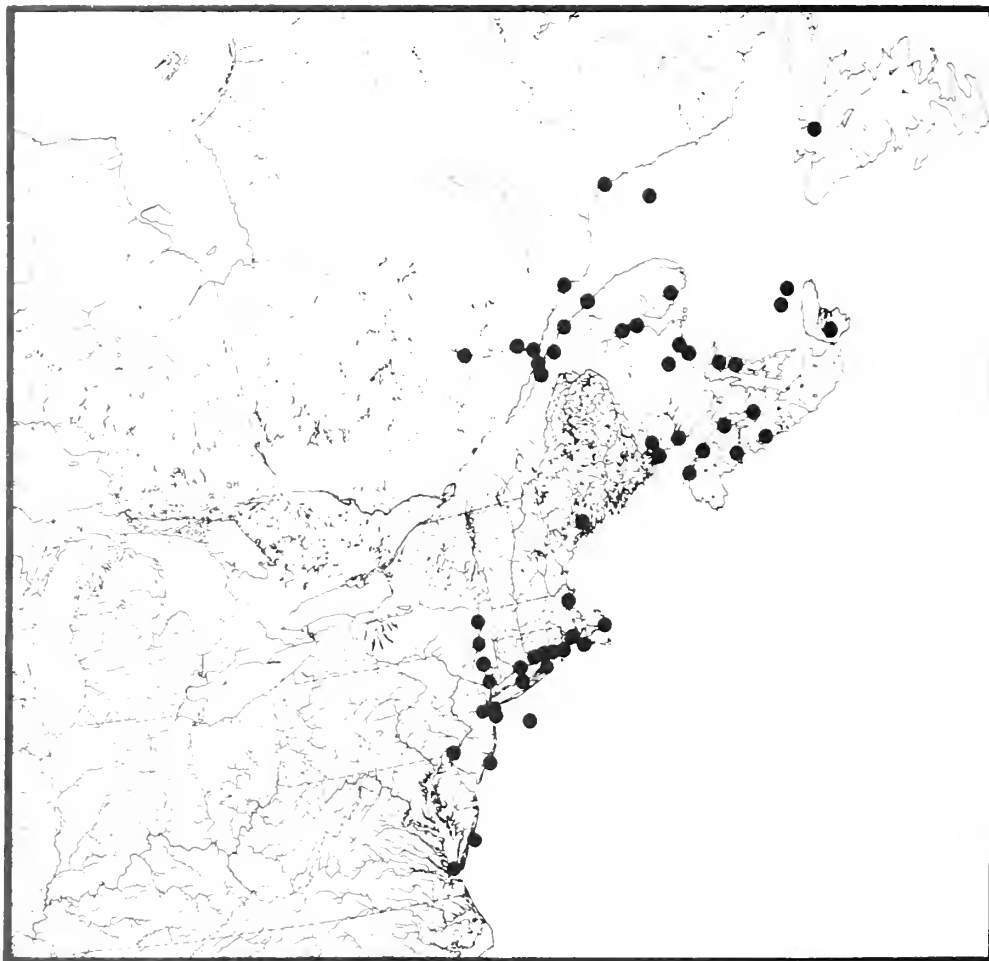
Order Gadiformes
Family Gadidae

TYPE LOCALITY: Long Island, NY (Walbaum in Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Subfamily Gadinae. Genus contains one other species, *M. proximus*, of Pacific northwest (Svetovidov 1948. *Fauna of the USSR*).



NB: Saint John River,
Westfield (NMC).



DISTRIBUTION AND HABITAT: Southern Labrador to mouth of Chesapeake Bay, VA. Bottom-dwelling species found in coastal marine waters, brackish estuaries, freshwater rivers, streams, and lakes (sometimes landlocked). Maximum salinity 31.4 ppt. Moves inshore into fresh water September through December, sometimes ascending streams for up to 225 km. Returns to coastal areas by late January.

ADULT SIZE: ca. 380 mm maximum.

BIOLOGY: Although considered wide-spectrum feeder, principal foods appear to be shrimps and amphipods. Despite sometimes extensive migrations up freshwater rivers, spawning typically occurs near or in tidal water, between November and late February (peak December or January) at 0 to 2.5 °C. Demersal, sometimes adhesive eggs deposited over bottom of sand or gravel. Details of early development presented by Booth (1967. Ph.D. diss., Univ. Connecticut) and Hardy (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 2)

Compiler: J. D. Hardy, Jr. November 1979.

Strongylura marina (Walbaum)
Atlantic needlefish

Order Atheriniformes
Family Belontiidae

TYPE LOCALITY: Long Island, NY (Walbaum in Artedi 1792. *Genera Piscium* 3: 4-723).

SYSTEMATICS: Often confused with, and listed in some literature as, *S. timucu* (Walbaum 1792), a valid species resurrected by Collette (1968. *Copeia*: 189-92). *Belone houttuyni* (Walbaum in Artedi 1792) of Mees (1962. *Zool. Verh.* 54:1-96) referable to this species (Collette and Berry 1966. *Bull. Zool. Nomencl.* 22:325-29).



FL: Marion Co., Silver
Springs Run, ca. 317 mm TL
(NCSM).



DISTRIBUTION AND HABITAT: Continental form from Casco Bay, ME, to at least Rio de Janeiro, Brazil. Only North American belonid that commonly enters fresh water. Moves upstream as far as the Fall Line. Replaced by *S. timucu* throughout Antilles and Bahamas, and both species are in FL and northeastern Gulf of Mexico (Collette 1968).

ADULT SIZE: 300-500 mm, 640 mm SL maximum.

BIOLOGY: Little information available. Spawns in fresh and brackish waters in shallows with submerged algal masses (Foster in Lippson and Moran 1974. *Manual for Identification of Early Developmental Stages of Fishes of the Potomac River Estuary*). Foster (1974) described early development. Food consists of small fish (Hildebrand and Schroeder 1928. *Bull. U.S. Bur. Fish.* 43:1-366). Parasites and host-parasite relationships discussed in Cressey and Collette (1971. *U.S. Fish. Bull.* 68:347-432).

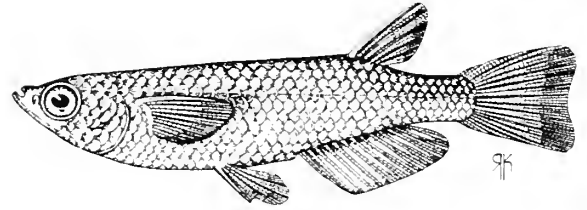
Compiler: G. H. Burgess. September 1978.

Oryzias latipes (Temminck and
Schlegel)
Medaka

Order Atheriniformes
Family Oryziatidae

TYPE LOCALITY: Japan (Temminck and Schlegel in Siebold 1846. *Fauna Japonica*: 1-324).

SYSTEMATICS: Genus (seven species) placed in separate family by Rosen (1964. *Bull. Am. Mus. Nat. Hist.* 127:217-68). Considered to be the most generalized of living cyprinodontoids.



(NCSM)



DISTRIBUTION AND HABITAT: Native distribution — Still or slow-moving fresh waters in Japan, Korea, southern Manchuria, eastern China, and as far south as Hainan. Apparently established in ponds in Suffolk Co., NY. Was established in a creek in Santa Clara Co., CA; population is probably no longer extant. Shows wide temperature and salinity tolerances. Sources of introductions into United States unknown; possibly due to releases of research and home aquarium fish.

ADULT SIZE: 29-33 mm SL, 40 mm SL maximum.

BIOLOGY: At least partially insectivorous. Sexual dimorphism most obvious in morphology of the dorsal and anal fins. At spawning, 20-40 eggs remain attached to genital opening of female until transferred to a plant. Literature on spawning summarized by Breder and Rosen (1966. *Modes of Reproduction in Fishes*). Bibliography for the species presented by Briggs and Egami (1959. *J. Fish. Res. Board Can.* 16[3]:363-80).

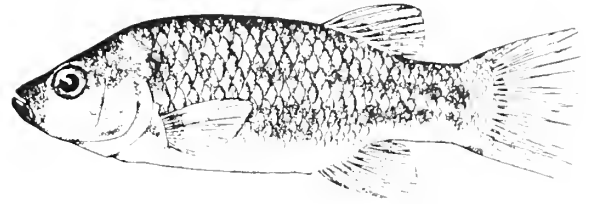
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Crenichthys baileyi (Gilbert)
White River springfish

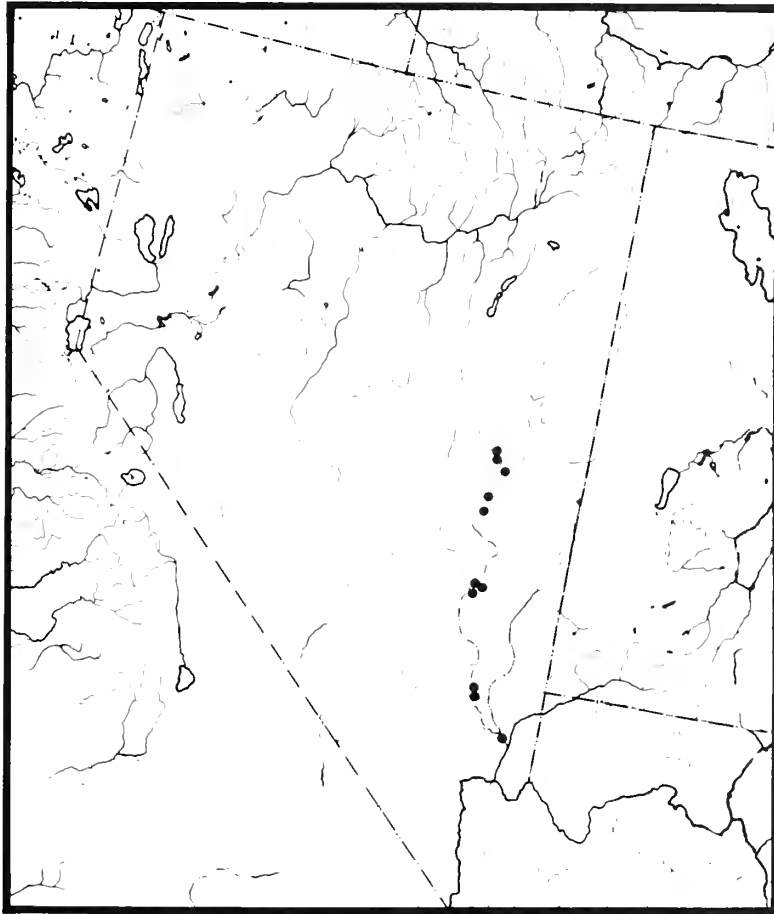
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Ash Springs in "Pah-ranagat Valley, NV" (Gilbert 1893. N. Am. Fauna 7:229-34).

SYSTEMATICS: One of two species of *Crenichthys* (other is *C. nevadae*). Because of morphological differences among several populations, caused by isolation in environmentally distinct springs, five subspecies proposed (Williams and Wilde, ms.).



(LaRivers 1962)



DISTRIBUTION AND HABITAT: Endemic to springs of pluvial White River in southeastern NV, including springs of Moapa River. Temperature and minimum oxygen values vary considerably among spring habitats, from 21° C and 3.3 ppm oxygen at Preston Big Spring to 37° C and 0.7 ppm at Mormon Spring. LaRiver (1962, *Fishes and Fisheries of Nevada*) found it to be common. One population extirpated and others threatened by exotic fish introductions.

ADULT SIZE: 35-40 mm SL, ca. 75 mm SL maximum.

BIOLOGY: LaRivers (1962) summarized fairly extensive biological information. Attention has centered around ability to withstand high temperature and low oxygen (Hubbs and Hettler 1964. *Southwest. Nat.* 9: 245-48), as well as decline when exotic fishes become established in the springs (Deacon et al. 1964. *Copeia*:384-88). Early life history stages described by Kopec (1949. *Copeia*:56-61). Eggs laid and fertilized individually, with 10-17 constituting spawning. Feeds mostly on small invertebrates.

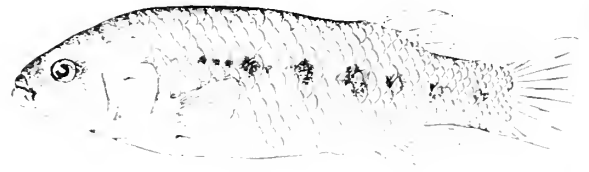
Compiler: J. E. Williams. August 1978.

Crenichthys nevadae Hubbs
Railroad Valley springfish

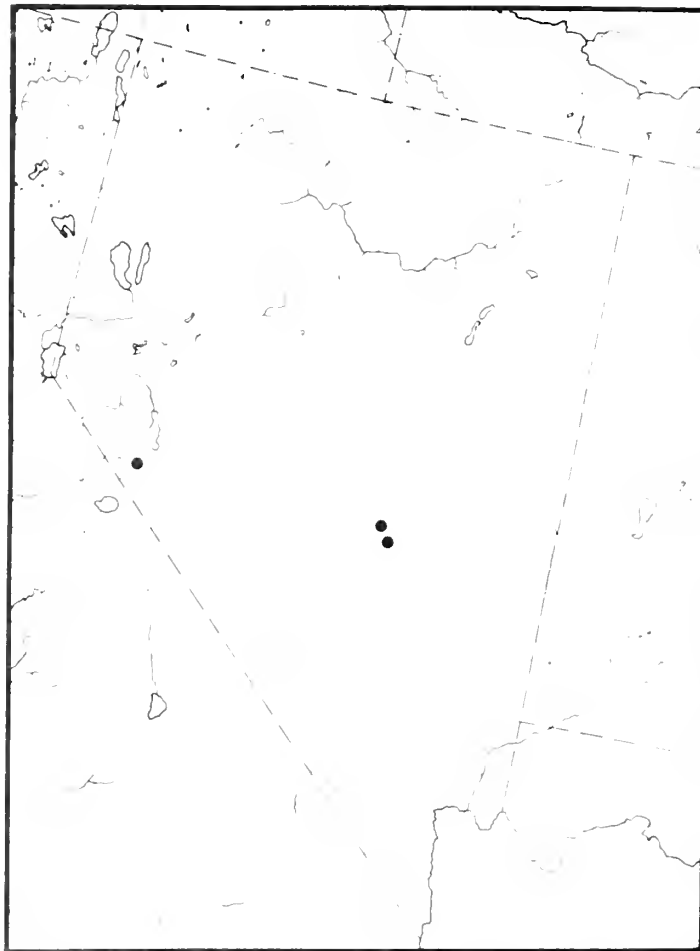
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Isolated warm spring at Duckwater, T12N, R56E, Nye Co., NV (Hubbs 1932. Occas. Pap. Mus. Zool. Univ. Mich. 252:1-5).

SYSTEMATICS: One of two species of *Crenichthys* (other is *C. baileyi*). Genus appears most closely allied to *Empetrichthys*, from which it differs principally in having bifid teeth and herbivorous feeding habits rather than conical teeth and omnivorous habits. Hubbs et al. (1974. Mem. Cal. Acad. Sci. 7:1-259) reviewed species and synonymy.



(LaRivers 1962)



DISTRIBUTION AND HABITAT: Native to springs near Duckwater and Lockes Ranch in Railroad Valley, Nye Co., NV. Only in warm springs, absent from nearby cool springs and creeks. Duckwater and Lockes Ranch springs have outflow temperatures of 32.3 and 37.3° C and minimum oxygen concentrations of 0.5 and 0.9 ppm, respectively. Successfully transplanted into warm springs at Sodaville, southwestern Mineral Co., NV in 1947 (LaRivers 1962. *Fishes and Fisheries of Nevada*). Hubbs et al. (1974) discussed zoogeography and distribution of this and other fishes in north-central Great basin area.

ADULT SIZE: 30-40 mm SL, ca. 50 mm SL maximum.

BIOLOGY: Little known. Hubbs et al. (1967 Am. Midl. Nat. 77:104-15) studied effects of low oxygen concentrations and light intensity on activity cycles. Intestine length indicates herbivory (Hubbs 1932). Most aspects of life history probably similar to *C. baileyi*.

Compiler: J. E. Williams. August 1978.

Cyprinodon bovinus Baird and
Girard
Leon Springs pupfish

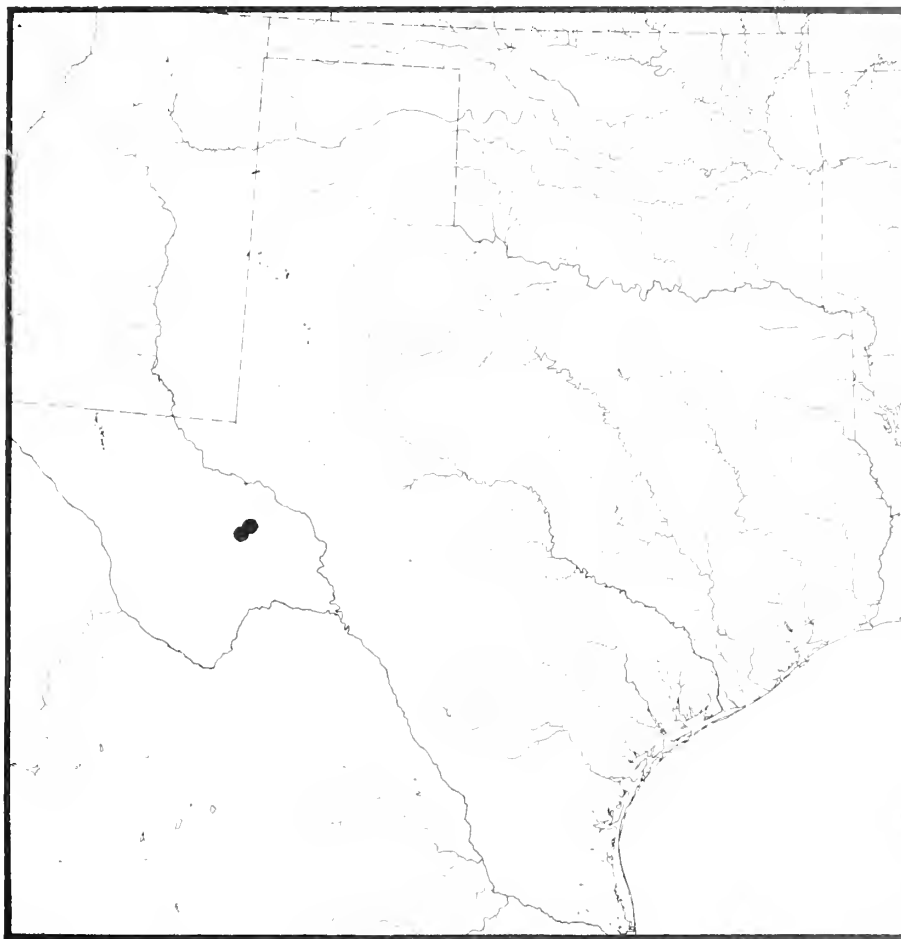
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Leon Springs, ca. 7 km
n of Fort Stockton, Rio Grande del Norte,
TX (Baird and Girard 1853. Proc. Acad. Nat.
Sci. Phila. [1852-53] 6:387-90).

SYSTEMATICS: Relationships with other
southwestern *Cyprinodon* species unclear
(Echelle and Miller 1974. Southwest. Nat.
19:179-90). Hybridizes extensively with *C.*
variegatus in nature (Kennedy 1977. Copeia:
93-103).



TX: Pecos Co., Leon Creek.
male, 29.5 mm SL, female, 31
mm SL (Echelle and Miller
1974).



DISTRIBUTION AND HABITAT: Believed
extinct until recently. Population at type lo-
cality extirpated. Known only from lower
portion of Leon Creek and Diamond-Y
Spring, Pecos Co., TX. Most abundant in
quiet water near edges of shallow pools, par-
ticularly those with minimal growths of
algae. Springs are typically quite hard, with
high levels of silica, sulphates, and chlorides.

ADULT SIZE: 30-45 mm SL.

BIOLOGY: Kennedy (1977) reported on life
history. Spawning reaches peak in July, but
actually occurs throughout year. Kennedy
(1977) described pit-digging activity, pre-
sumed related to food location. Food consists
primarily of diatoms and algae, and to a
lesser extent amphipods, gastropods, and os-
tracods.

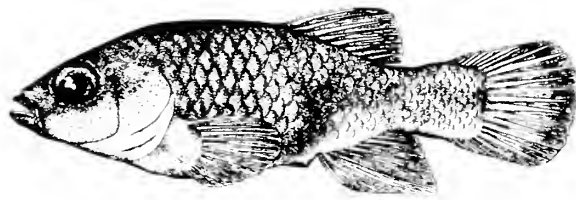
Compilers: F. C. Rohde and V. Guillory.
March 1978.

Cyprinodon diabolis Wales
Devils Hole pupfish

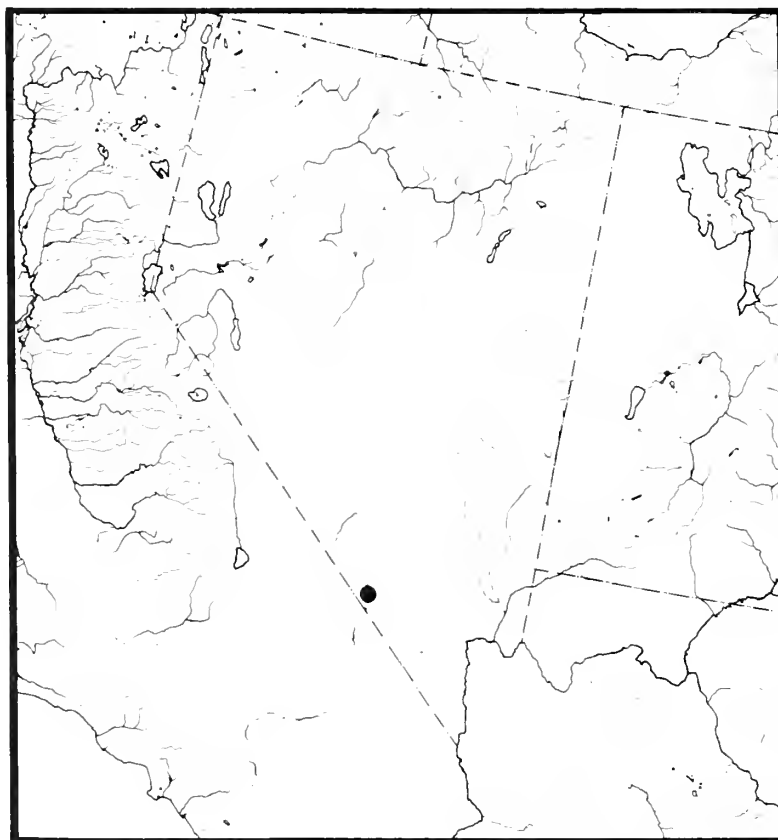
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Devils Hole, Ash Meadows, Nye Co., NV (Wales 1930, Copeia: 61-70).

SYSTEMATICS: Apparent derivative of *C. neradensis* (Miller 1948, Misc. Publ. Mus. Zool. Univ. Mich. 68:1-155), but quite distinct from this species (Soltz and Naiman 1978, Nat. Hist. Mus. Los Ang. Cty. Sci. Ser. 30:1-76).



NV: Nye Co., Devils Hole
(LaRivers 1962).



DISTRIBUTION AND HABITAT: Restricted to single, deep limestone pool at bottom of Devils Hole, central Ash Meadows, Death Valley National Monument, NV. Feeds and spawns on algae-covered ledge at western end of pool, rarely entering scum-covered waters of unknown depth at eastern end (Miller 1948; James 1969, M.S. thesis, Univ. Nevada, Las Vegas). Mining of aquifer for irrigation has steadily lowered water levels (Dudley and Larson 1976, U.S. Geol. Surv. Prof. Pap. 927:1-52), but 1976 U.S. Supreme Court ruling protects habitat (Sanchez 1976, Natl. Park Serv. Newsl. 11:2). Water temperature 32.8 to 33.9°, dissolved oxygen 1.8 to 3.3 ppm (Miller 1948; LaRivers 1962, *Fishes and Fisheries of Nevada*). Transplants to two isolated natural springs apparently unsuccessful. Captive population in man-made pool below Hoover Dam (Sharpe et al. 1975, Recl. Era 59:24-29).

ADULT SIZE: Average 18 mm SL; 28 mm SL maximum.

BIOLOGY: Breeding appears to continue throughout year (LaRivers 1962). Population size in late 1930s ranged from 50 to 400 by actual count (Miller 1948). Fluctuated seasonally from 200 to 800 (around 315 in June 1976), and at around 400 in 1978 (Deacon and Deacon 1978, 1st Ann. Symp. Res. Natl. Parks, in press). Principal food algae; beetle larvae and flatworms consumed in quantity may be secondarily ingested while grazing rocks (LaRivers 1962). Species displays some neotenic characters. General summary in Soltz and Naiman (1978).

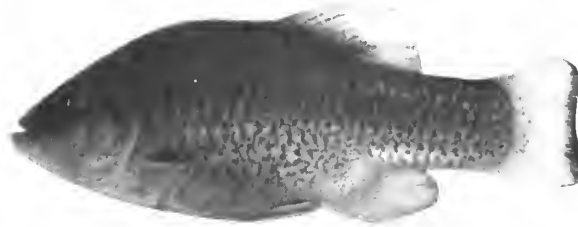
Compilers: A.W. Allen and J.E. Cooper, June 1979.

Cyprinodon elegans Baird and
Girard
Comanche Springs pupfish

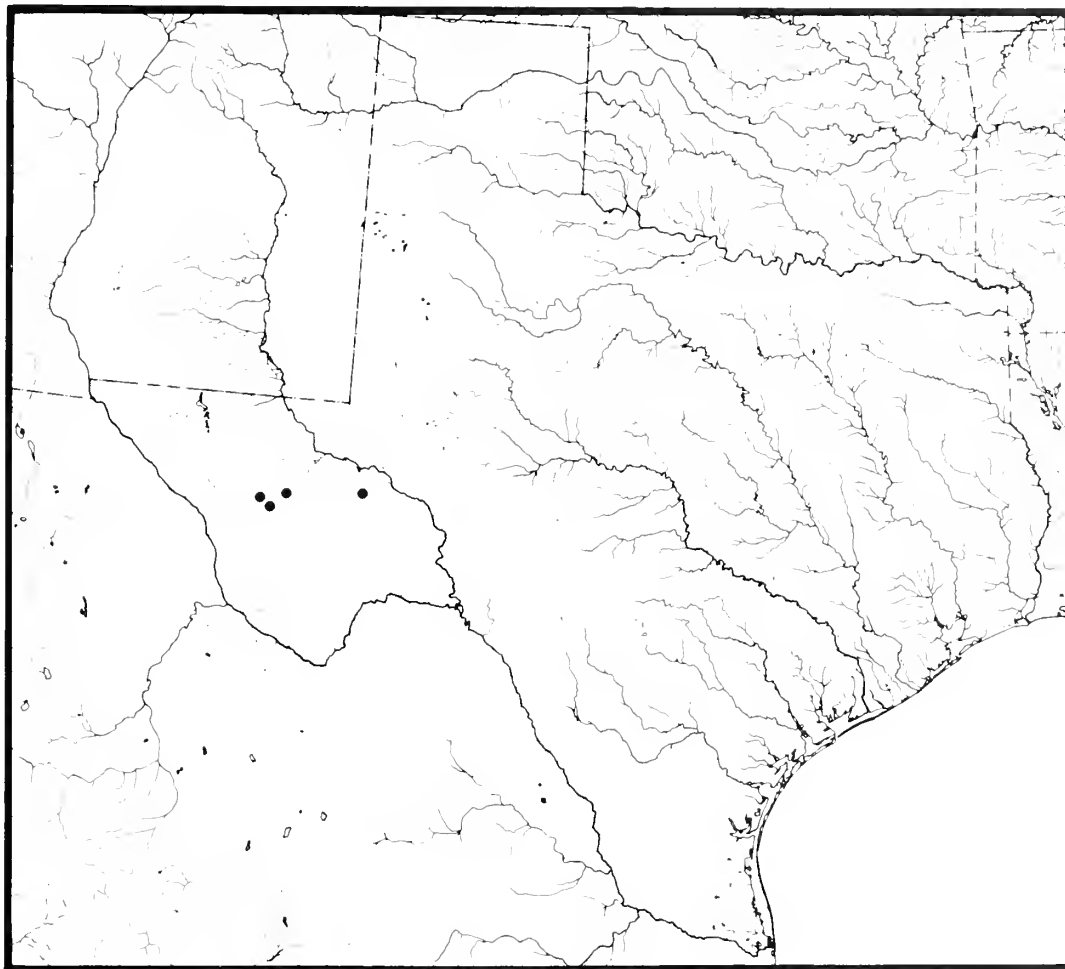
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Rio Grande del Norte (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. [1852-53] 6:387-90).

SYSTEMATICS: Placed in *C. variegatus* complex (Liu 1969. Ph.D. diss., Univ. California, Los Angeles). Hybrid swarm with *C. variegatus* examined by Stevenson and Buchanan (1973. Copeia: 682-92). Morphological variation discussed by Echelle (1975. Tex. J. Sci. 16:529-38).



TX: Jeff Davis Co., Phantom Springs ditch, male, 27 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Presently restricted to San Solomon and Phantom Cave springs, downstream irrigation canals, and Lake Balmorea, Reeves Co., TX. Extirpated from Comanche Springs, Pecos Co., TX. Springs have constant discharge, but downstream water levels vary with irrigation demands. Canals characterized by swift currents. Rarely found in concrete flumes where water depth less than 10 cm and/or bottom scoured of debris, but often abundant in earthen ditches and concrete flumes 10 cm or more deep with bottoms covered by debris and *Chara*.

ADULT SIZE: 30-45 mm SL.

BIOLOGY: General ecology and hybridization with *C. variegatus* discussed by Stevenson and Buchanan (1973). Breeding behavior (Itzkowitz 1969. Tex. J. Sci. 21:229-31), thermal and ecological features (Gehlbach et al. 1978. Tex. J. Sci. 30:99-101), and general ecology (Echelle 1975) have been studied. Liu (1969) and Drewery (1967. Ph.D. diss., Univ. Texas) crossed *C. elegans* in laboratory with other *Cyprinodon*.

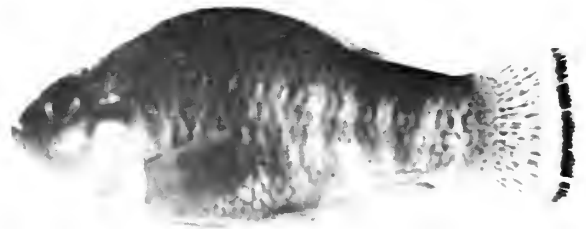
Compiler: V. Guillory. November 1978.

Cyprinodon eximius Girard
Conchos pupfish

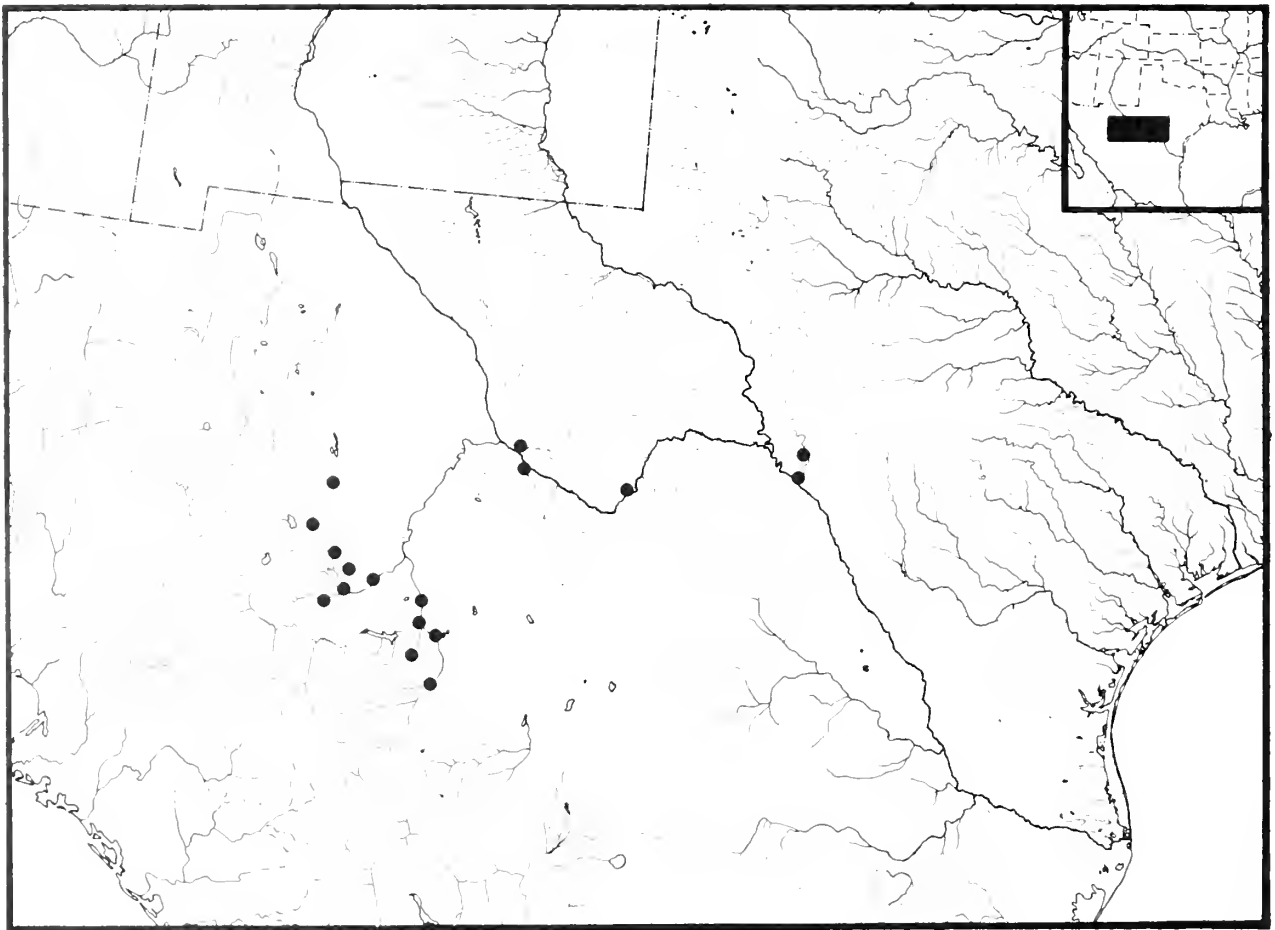
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Chihuahua River (= Rio Chuvistar, at Chihuahua City) Mexico (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:157-61).

SYSTEMATICS: Most widespread member of distinctive complex of seven species occupying Chihuahuan Desert Region of north central Mexico and southern TX (Miller 1976. Bull. South. Calif. Acad. Sci. 75: 68-75).



Mexico: Chihuahua, Rio Conchos at Jimenez, male, 34 mm (Miller 1976).



DISTRIBUTION AND HABITAT: Locally abundant in Rio Conchos basin, Chihuahua, Mexico, a major tributary of Rio Grande; Rio Sauz basin (Minckley and Koehn 1965. Southwest. Nat. 10:313-15); and tributaries of Rio Grande east to Val Verde Co., TX (Miller 1976). Typical of sloughs, backwaters, and margins of larger streams, channels of creeks (in Mexico), and mouths of creeks tributary to larger rivers; rarely in headsprings.

ADULT SIZE: Rarely exceeds 40 mm SL.

BIOLOGY: Essentially unknown. Behaviour under laboratory conditions described by Liu (1970. Diss. Abstr. Int. B30: 5298B) Some populations excavate feeding pits in soft substrates, as do numerous other pupfishes (Minckley and Arnold 1969. J. Ariz. Acad. Sci. 4:254-57).

Compiler: W. L. Minckley. December 1979.

Cyprinodon macularius Baird and
Girard
Desert pupfish

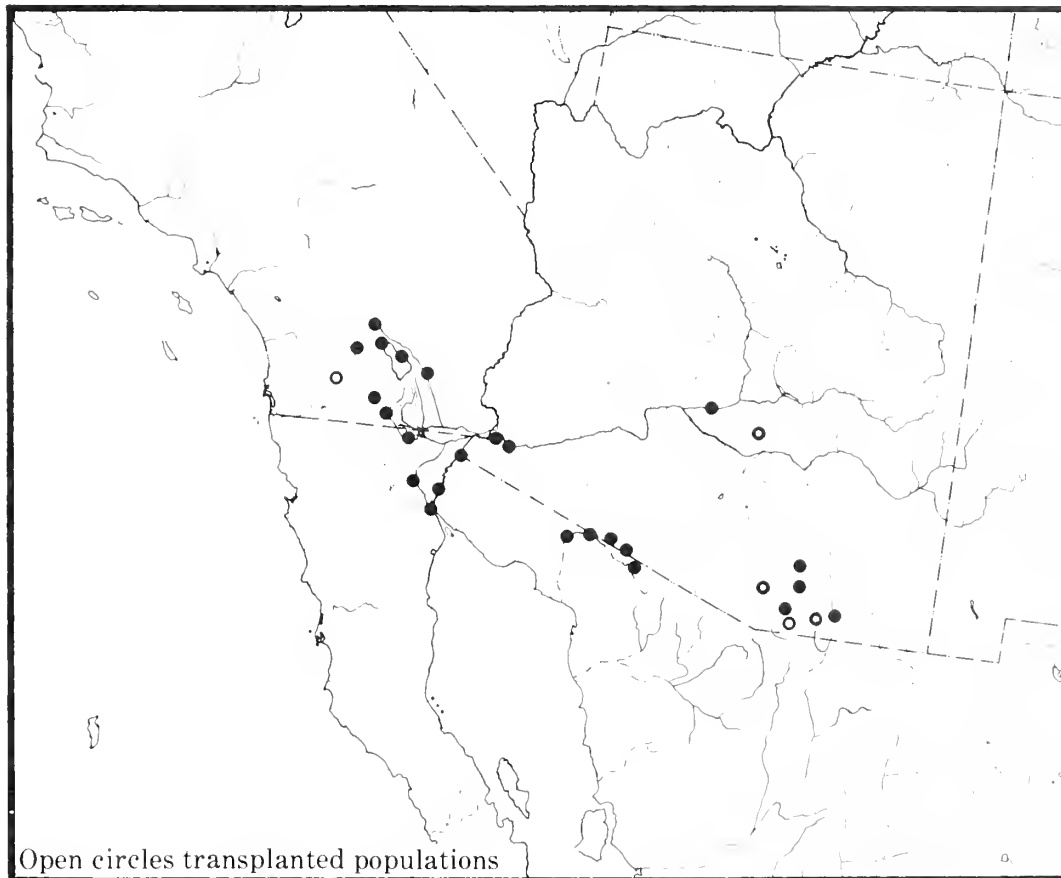
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Rio San Pedro (tributary of Rio Gila), AZ (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. [1852-53] 6:387-90).

SYSTEMATICS: Systematics and synonymy discussed in detail by Miller (1943. Occas. Pap. Mus. Zool. Univ. Mich. 473:1-25). Probably more closely related to species farther east than to *Cyprinodon* of Death Valley system (Miller 1948. Misc. Publ. Mus. Zool. Univ. Mich. 68:1-155).



CA: Imperial Co., canal near Salton Sea, male, 30 mm SL, female, 20 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Lower Colorado and Gila Rivers, from southern AZ to eastern lower CA, and Sonoyta River of northern Sonora, Mexico. Populations have established in Salton Sea and its main tributary, San Felipe Creek. Also introduced in Anza-Borrego State Park, CA, Boyce Thompson Arboretum and elsewhere in AZ. Survives in variety of habitats and typically in ones with harsh or extreme environmental fluctuations in oxygen, temperature, and salinities, which preclude competitive or predaceous fishes.

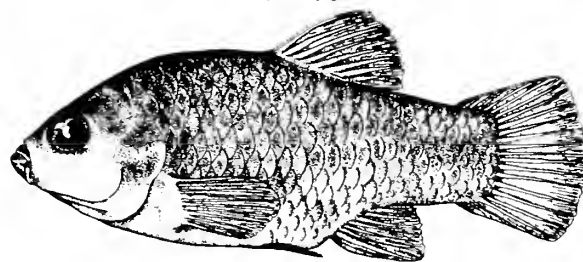
ADULT SIZE: ca. 60 mm SL maximum.

BIOLOGY: Life history summarized by Minckley (1973. *Fishes of Arizona*) and Moyle (1976. *Inland Fishes of California*). Typically in loose schools of similar size and age, from which small groups depart to forage. Some populations burrow in loose debris and become dormant during extreme temperatures. Feeds on small invertebrates and algae gleaned from substrate. Growth rapid but varies with temperature and salinity. May become sexually mature at 15 mm TL and complete entire life cycle in one summer. Spawns April to October at 20°C. Spawning behavior described by Barlow (1961. Am. Midl. Nat. 65:339-59).
Compiler: W. L. Minckley. December 1979.

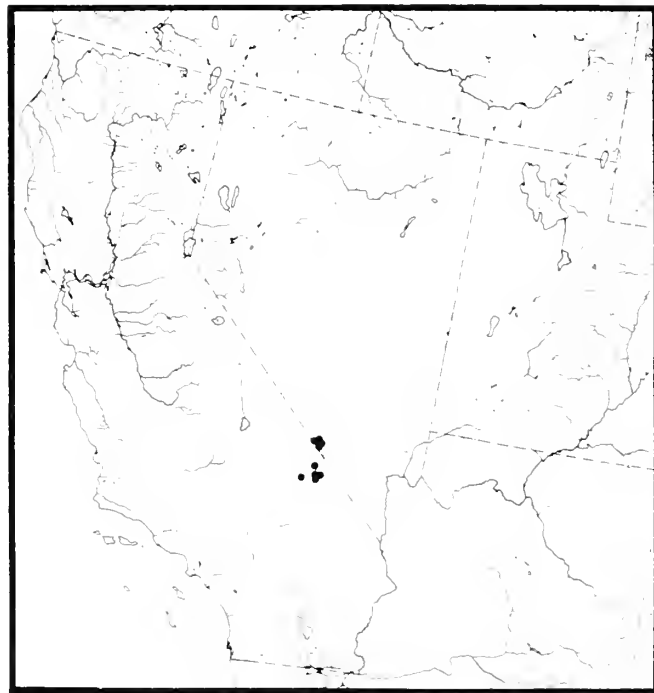
Cyprinodon nevadensis (Eigenmann
and Eigenmann)
Amargosa pupfish

Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: "Saratoga Spring" in southern Death Valley, Inyo Co. (San Bernardino Co.), CA (Eigenmann and Eigenmann 1889, Proc. Calif. Acad. Sci. 1:270). **SYSTEMATICS:** Closely related morphologically to *C. macularius* and believed by Jordan (1924, Proc. Acad. Nat. Sci. Phila. 76:23-24) to be synonymous. Jordan et al. (1930, Rept. U.S. Comm. Fish. [1929], [Pt. 2]: 1-670) and Evermann and Clark (1931, Calif. Div. Fish Game Fish. Bull. 35:1-67) recognized *C. nevadensis* as valid species restricted to Saratoga Spring, CA. Miller (1943, Occas. Pap. Mus. Zool. Univ. Mich. 473:1-35; 1948, Misc. Publ. Mus. Zool. Univ. Mich. 68:1-155) recognized six subspecies in isolated areas of Amargosa River system: *C. n. nevadensis*, *C. n. amargosae*, *C. n. mionectes*, *C. n. pectoralis*, *C. n. calidae*, and *C. n. shoshone*. Turner (1973, Comp. Biochem. Physiol. 46B:57-70) used electrophoresis to show genetic distinction of *C. nevadensis*.



CA: Inyo Co., female, 42 mm
SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Springs and streams in Amargosa River Basin, CA and NV. Six subspecies recognized: *C. n. nevadensis* from Saratoga Springs; *C. n. calidae* originally from north and south Tecopa Hot Springs, Inyo Co. (now thought extinct); *C. n. shoshone* from Shoshone Springs, Inyo Co. (also thought extinct); *C. n. amargosae* from Tecopa Bore (an artesian well outflow), Tecopa Hot Springs drainage ditches, permanent waters of Amargosa River, and Badwater, CA; *C. n. pectoralis* from Scruggs Springs 1 and 2, and School Spring near Devils Hole, Nye Co., NV, and formerly from nearby Mexican Spring; and *C. n. mionectes* from springs and waterholes of Ash Meadows, Nye Co., NV, including Fairbanks, Longstreet, Point of Rocks, Big, and Jackrabbit springs.

BIOLOGY: Summarized by Moyle (1976, *Inland Fishes of California*). The six subspecies inhabit wide variety of environments. Temperatures in Amargosa River's extremely saline waters fluctuate from freezing in winter to over 40°C in summer, while springs are relatively temperature-stable year round. Growth rates and number of annual generations consequently variable. Miller (*in* Blair [ed.], 1961, *Vertebrate Speciation*: 537-60) stated stream populations of *C. nevadensis* may have two or three generations per year. Sexual maturity reached at 25-30 mm SL. Liu (1969, Ph.D. diss., Univ. California, Los Angeles) discussed spawning behavior. Maximum temperature tolerance for *C. nevadensis* is 43°C. Food primarily blue-green algae, with small invertebrates also eaten.

ADULT SIZE: 25-65 mm SL.

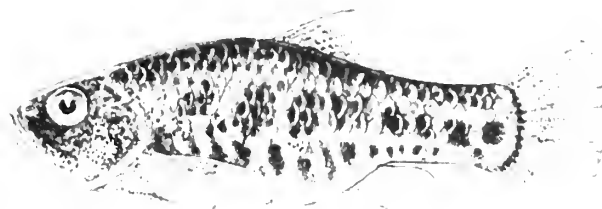
Compiler: E. Esmond, January 1980.

Cyprinodon pecosensis Echelle and
Echelle
Pecos River pupfish

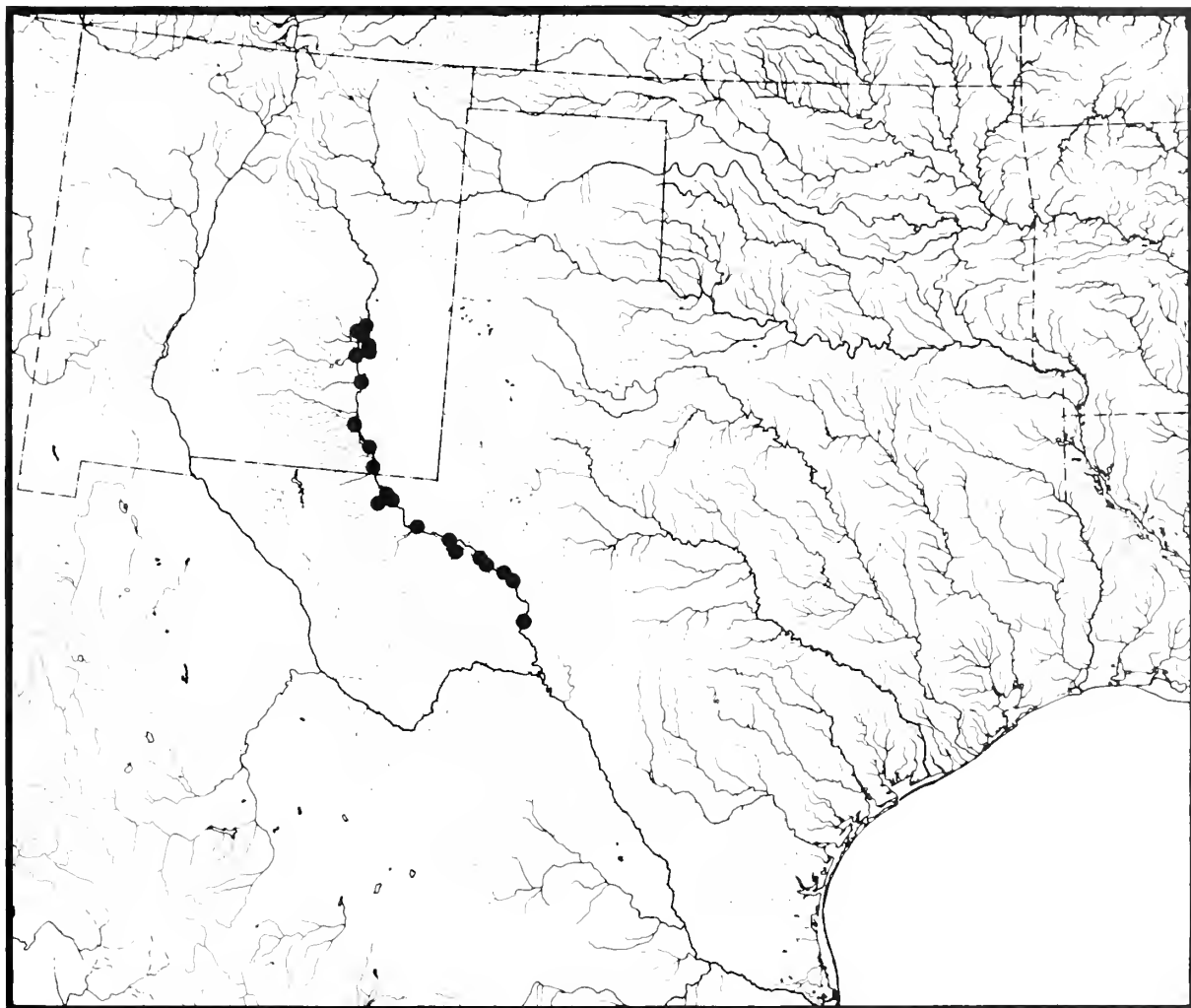
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Oxbow of Pecos River at Bitter Lake National Wildlife Refuge, 11.6 km e, 8 km n Roswell, Chaves Co., NM (Echelle and Echelle 1978. Copeia: 569-82).

SYSTEMATICS: Species of *C. variegatus* complex (Liu 1969. Ph.D. diss., Univ. California, Los Angeles), most resembling *C. rubrofluvialis* (Echelle and Echelle 1978) in general appearance.



(NCSM)



DISTRIBUTION AND HABITAT: Pecos River system, from mouth of Independence Creek, 42 km southeast of Sheffield, Terrell Co., TX, to Roswell, Chaves Co., NM. Occurs in saline springs, gypsum sinkholes, and desert streams. Sometimes collected in low salinity waters, but most typical in highly saline habitats that support relatively few species (Echelle and Echelle 1978).

ADULT SIZE: 27.3 - 45.9 mm SL.

BIOLOGY: Echelle and Echelle (1978) reported *C. pecosensis* ecologically more similar to *C. bovinus* than to *C. elegans*.

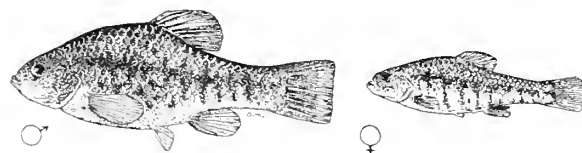
Compiler: A. W. Allen, March 1979.

***Cyprinodon radiosus* Miller**
Owens pupfish

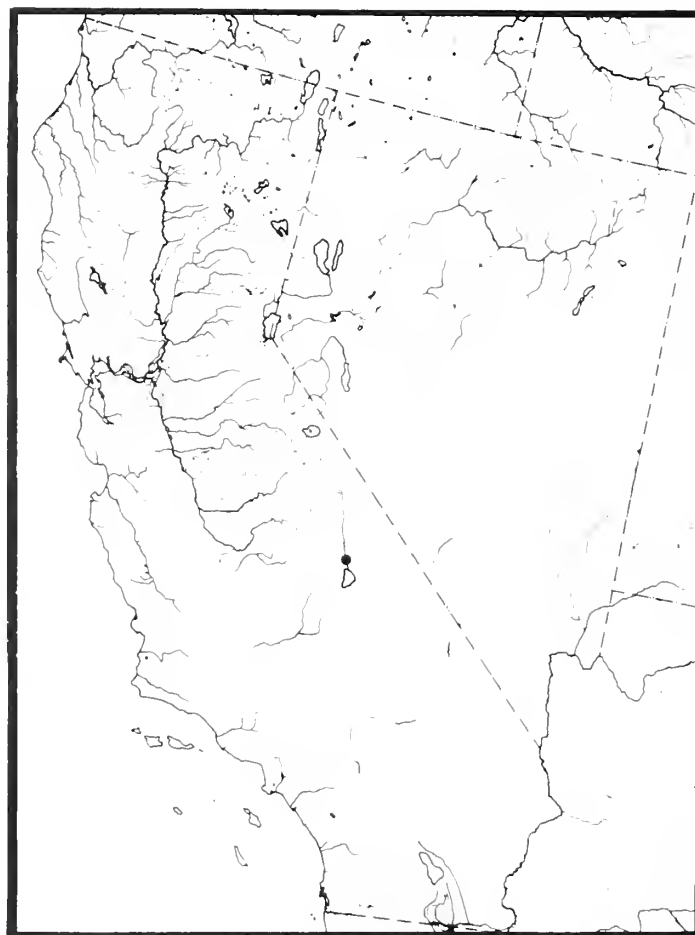
Order Atheriniformes
 Family Cyprinodontidae

TYPE LOCALITY: Fish Slough, ca. 16.1 km n of Bishop, Mono Co., CA (Miller 1948. Misc. Publ. Mus. Zool Univ. Mich. 68:1-155).

SYSTEMATICS: Miller (1948) and Soltz and Naiman (1978. Nat. Hist. Mus. Los Ang. Cty. Sci. Ser. 30:1-76) provided data on diagnostic characters.



CA: Inyo Co., male, 41 mm SL, female, 35 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Endemic to Owens Valley from vicinity of Lone Pine, Inyo Co., north to source springs of Fish Slough, Mono Co., CA. Once abundant in shallow, clear, warm (10-25°C) sloughs, irrigation ditches, swamps, and bog pastures along Owens River. Has survived in three protected habitats near Bishop, CA (Miller and Pister 1971, Trans. Am. Fish. Soc. 100: 502-09; Soltz and Naiman 1978).

ADULT SIZE: 30-45 mm SL, 60 mm SL maximum.

BIOLOGY: Forages in small schools, feeding predominantly on aquatic insects. Kennedy (1916. Calif. Fish Game 2:179-82) concluded species important in control of mosquitoes. Breeds during first year. Spawning behavior similar to that of other desert pupfish (Liu 1969. Ph.D. diss., Univ. California, Los Angeles). Moyle (1976. *Inland Fishes of California*) provided summary of biology and history of rediscovery and management of species.

Compilers: D. S. Lee and A. W. Allen.
 March 1979.

Cyprinodon rubrofluvialis Fowler
Red River pupfish

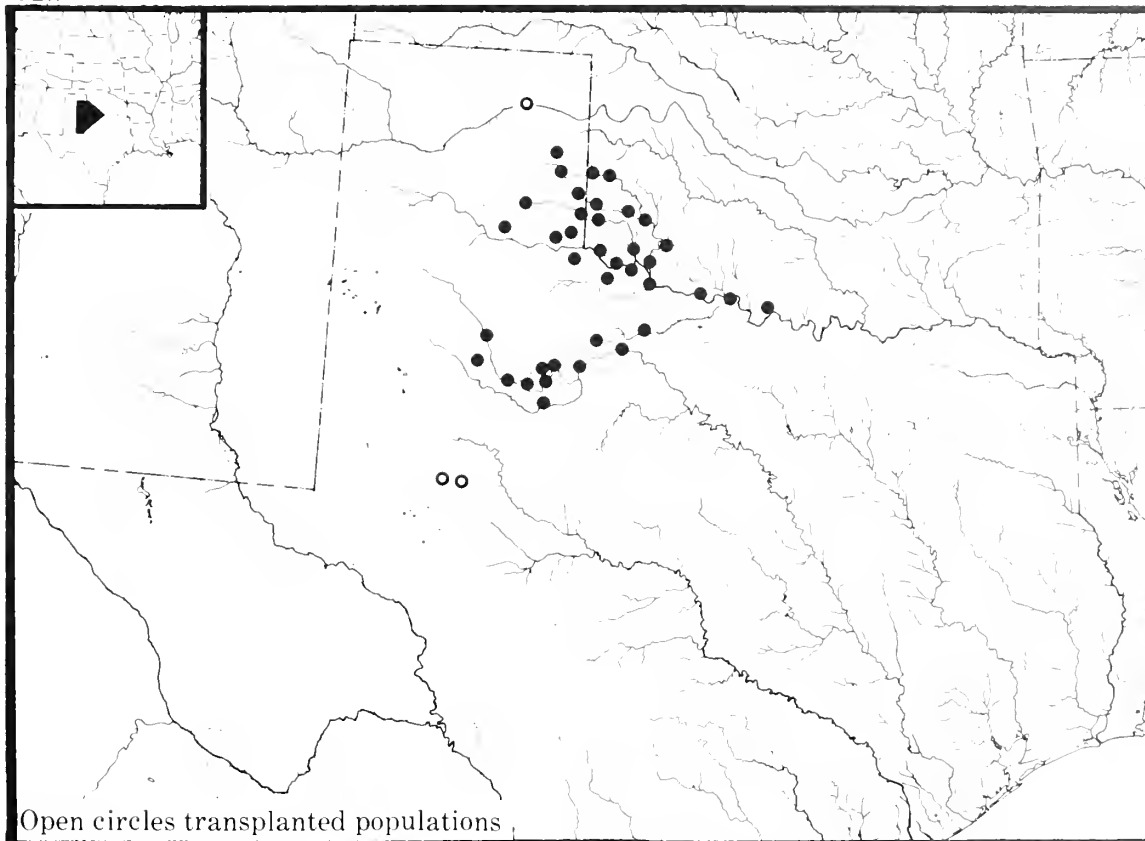
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Brazos River, Seymour, TX, and Red River, Tulip and Clarendon, TX (Fowler 1916. Proc. Acad. Nat. Sci. Phila. 68:415-39).

SYSTEMATICS: Derived from ancestor similar to *C. variegatus* that invaded Rio Grande region and moved to adjacent exo- and endorheic basins of High Plains and Chihuahuan Deserts to give rise to number of species (Miller and Echelle 1975. Southwest. Nat. 19:365-77). Perhaps most closely related to *C. pecosensis* of adjacent Pecos River System (Echelle and Echelle 1978. Copeia: 569-82).



(NCSM)



DISTRIBUTION AND HABITAT: Common in headwater streams of xeric grasslands of Red and Brazos river systems of western OK and TX (Echelle 1973. Copeia: 68-76); recently found and probably introduced in upper Arkansas and Colorado rivers, TX (Echelle et al. 1977. Southwest. Nat. 22: 142-43). Inhabits shallow waters where temperatures vary from -1 to 39°C (Echelle et al. 1972a. Southwest. Nat. 17: 55-60) and salinity may exceed 3‰ (Hill and Holland 1971. Southwest Nat. 16:55-63). Habitats at most a few cm deep, clear except in flood, and soft-bottomed.

ADULT SIZE: Rarely exceeds 45 mm SL.

BIOLOGY: Spawns February into November, maximum spawning in July and August. Males highly territorial, resulting in protection of eggs and protection from disturbance for courting activities. Bottom-oriented feeding activity consists of schools of mixed sexes at 4 - 15°C, but becomes solitary and territorial above 15°C (Echelle et al. 1972a). Selection apparently favored attainment of "numbers advantages" in density-dependent competitive interactions (Echelle et al. 1972b. Am. Midl. Nat. 88: 109-30). Achieves greatest population sizes in places inhabited by few other species, mostly as result of great tolerance to physical and chemical environmental extremes.

Compiler: W. L. Minckley, December 1979.

Cyprinodon salinus Miller
Salt Creek pupfish

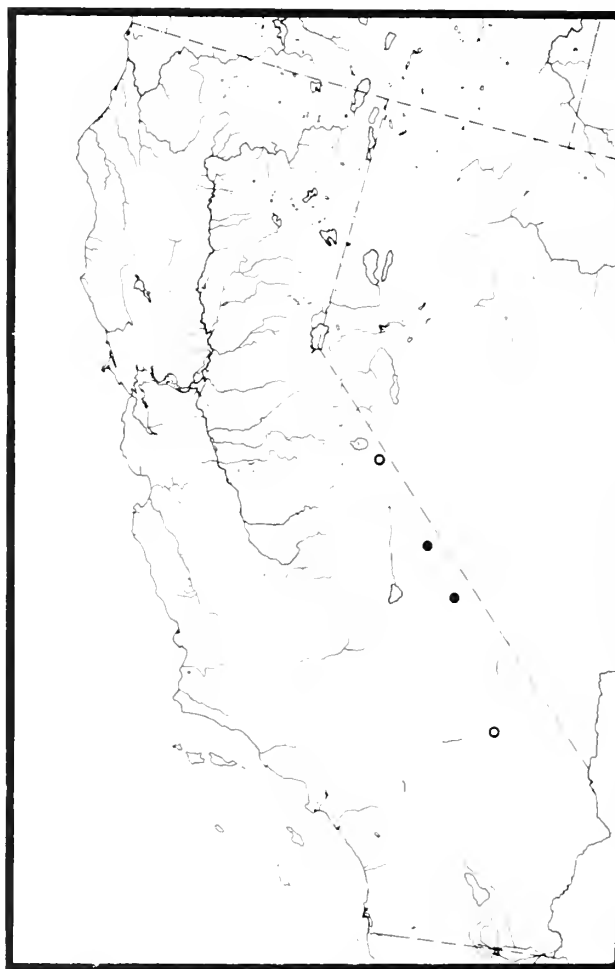
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Salt Creek, Death Valley, Inyo Co., CA (Miller 1943. Copeia:69-78).

SYSTEMATICS: Miller (1948. Misc. Publ. Mus. Zool. Univ. Mich. 68:1-155) compared this species with other western members of the genus and indicated its closest relative to be *C. nevadensis*.



CA: Inyo Co., Salt Creek, male, 28 mm SL, female, 25 mm SL (Moyle 1976).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Originally confined to a 2.5 km section of Salt Creek in northern Death Valley, 55-76 m below mean sea level. Miller (1968. Calif. Fish Game 54:170-79) noted that transplanted populations have been established in Soda Lake, San Bernardino Co., and River Springs, Mono Co., CA. Pupfish inhabit as much of the area as fluctuating flow permits, but are frequently confined to vegetation-lined pools where salinity approaches that of sea water. Population sizes exhibit marked fluctuation.

ADULT SIZE: 26-48 mm SL, 65 mm SL maximum.

BIOLOGY: Brown and Feldmeth (1971. Evolution 25:390-98) and LaBounty and Deacon (1972. Copeia:769-80) found that this pupfish can tolerate temperatures up to 42°C and salinity twice that of sea water. Miller (1943) estimated peak populations to number in the millions. Rapid population increase indicates a generation time of two to three months. Most other life history aspects are similar to those of *C. macularius* (Liu 1969. Ph.D. diss., Univ. California, Los Angeles).

Compiler: D. S. Lee. June 1978.

***Cyprinodon tularosa* Miller and
Echelle**
White sands pupfish

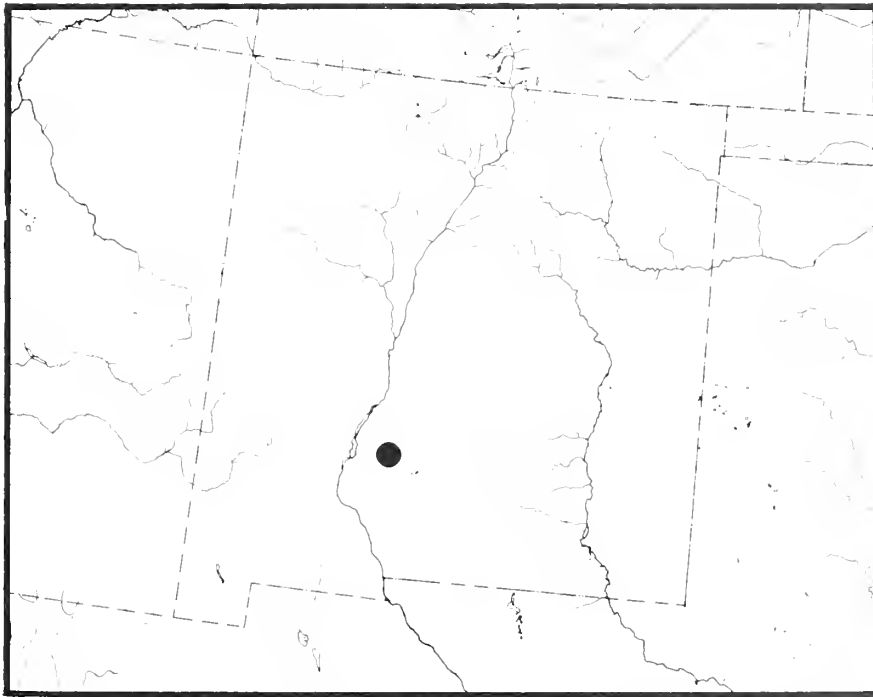
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Malpais Spring, about 26 km wsw of Three Rivers, Otero Co., NM (Miller and Echelle 1975. Southwest. Nat. 19:365-77).

SYSTEMATICS: Apparent nearest relatives are *Cyprinodon* species from Rio Grande basin: *C. borinus*, *C. elegans*, *C. rubrofluvialis*, and *C. variegatus* (Miller and Echelle 1975).



NM: Socorro Co., Malpais Spring, male, 35 mm SL
(Miller and Echelle 1975)



DISTRIBUTION AND HABITAT: Endemic to Tularosa Valley, southern NM. Found in clear water over a bottom ranging from sand and gravel to silt and mud. Pools and creeks are highly mineralized and charged with alkali and salt (15 ppt dissolved salt in Malpais Spring and 35 ppt in adjacent Salt Creek). Submerged and emergent vegetation and filamentous green algae may be present. Abundant at least at type locality.

ADULT SIZE: 24-42 mm SL.

BIOLOGY: Nothing known.

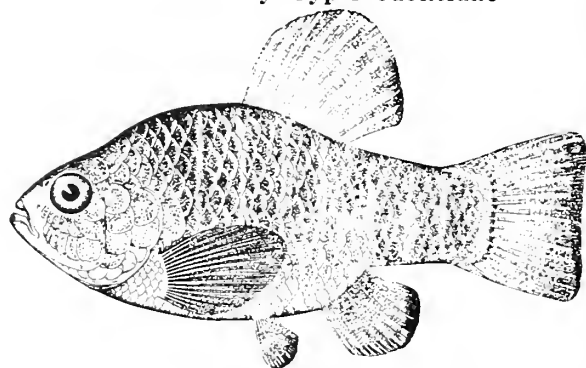
Compiler: F. C. Rohde. May 1978.

Cyprinodon variegatus Lacepede
Sheephead minnow

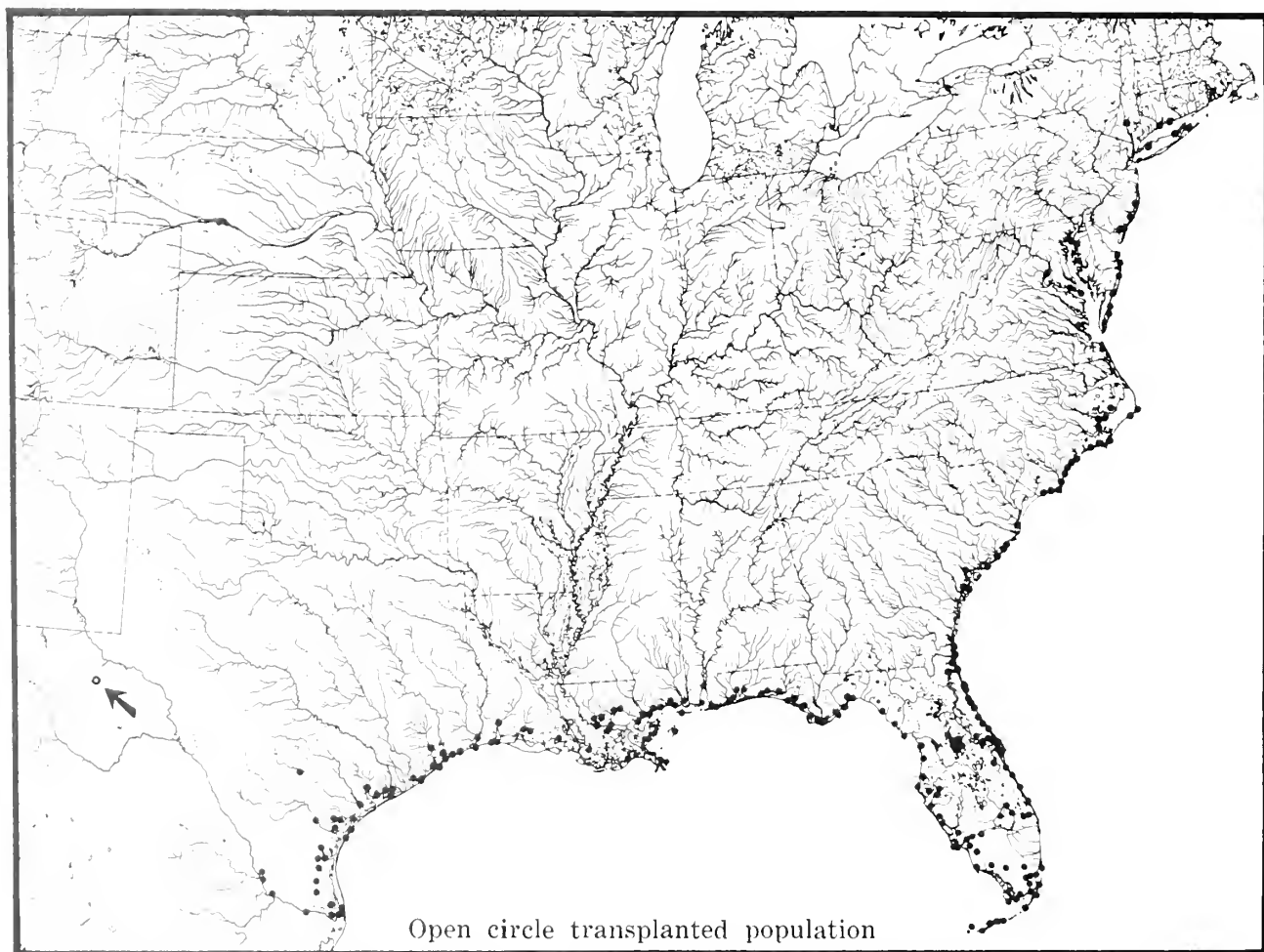
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: "South Carolina" (Lacepede 1803. *Histoire Naturelle des Poissons* 5:1-803).

SYSTEMATICS: Four subspecies described, of which only nominate form and *C. v. ovinus* distinguishable on morphological and electrophoretic grounds (Darling 1976. Ph.D. diss., Yale Univ.). Johnson (1974. M.S. thesis, Florida Tech. Univ.) recognized *C. hubbsi* as an additional subspecies.



MD: St. George Island, male
(Jordan and Evermann 1900).



Open circle transplanted population

DISTRIBUTION AND HABITAT: Coastal species in relatively shallow brackish or fresh water, from MA to Yucatan Peninsula, Mexico. Also in Bahamas, and Grand Cayman Island in Caribbean. Locally may be very abundant where bottom at least partially sandy, emergent vegetation lacking, and little current or wave action present. May establish populations in fresh water lakes containing relatively high dissolved solids.

ADULT SIZE: 35-50 mm SL.

BIOLOGY: Tolerant of extreme changes in temperature and salinity (Simpson and Gunter 1956. *Tulane Stud. Zool* 4:113-34). Raney et al. (1953. *Zoologica* 38:97-104) described reproductive behavior. Comprehensive studies have been conducted, summarizing an abundance of literature, on biology (Foster 1967. Ph.D. diss., Cornell Univ.), ecology, and behavior (Kaill 1968. Ph.D. diss., Cornell Univ.) of *C. variegatus*.

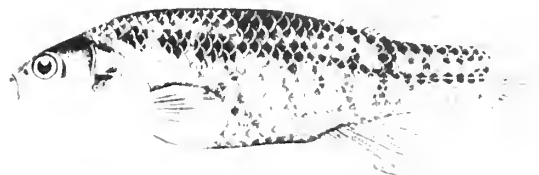
Compiler: W. E. Johnson. June 1978.

Empetrichthys latos Miller
Pahrump killifish

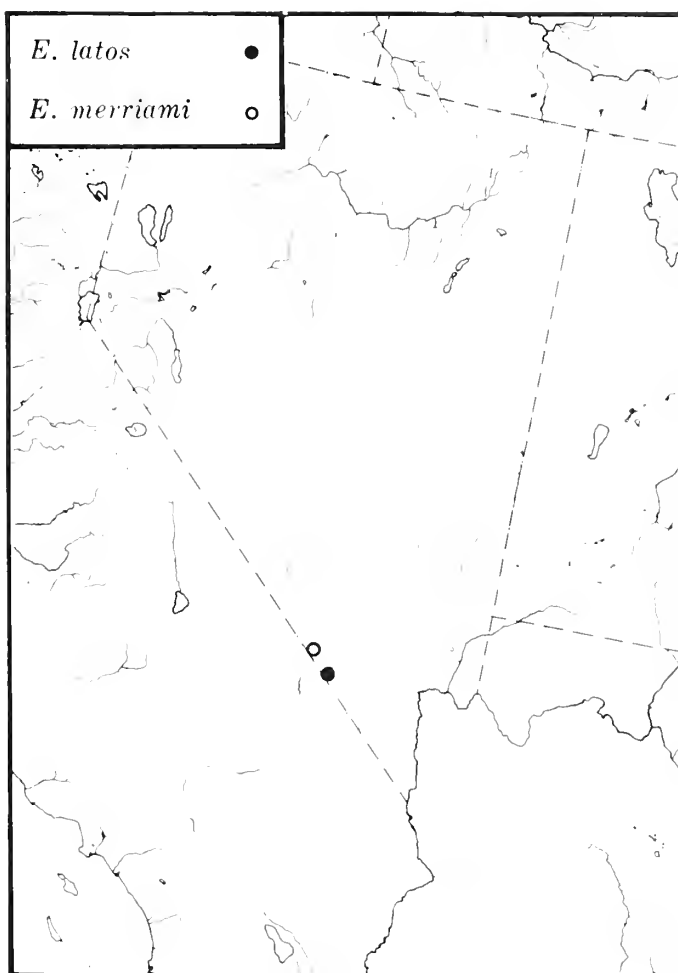
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Main spring pool of Manse Ranch, Pahrump Valley, Nye Co., NV (Miller 1948, Misc. Publ. Mus. Zool. Univ. Mich. 68:1-555).

SYSTEMATICS: One of two species in genus (see *E. merriami*). Miller (1948) recognized three subspecies, *E. i. latos*, *E. i. pahrump*, and *E. i. conearvus*, each confined to a single spring.



(NCSM)



DISTRIBUTION AND HABITAT: Originally confined to three separate springs in Pahrump Valley, Nye Co., NV, where it is the only native fish. All localities are within 9.7 km of Pahrump Ranch. An endemic of shallow warm springs (23.3 - 25.3° C). Miller (1948) described main spring pool as 15 m wide, 0.3-1.8 m deep with clear water and silt bottom. Apparently abundant prior to habitat alterations and introduction of other species. *Empetrichthys l. latos*, the only sur-

viving subspecies (Hubbs et al. 1974. Mem. Calif. Acad. Sci. 7:1-259), is confined to Manse Spring. Transplanted in 1972 to spring-fed pools in Spring Valley, but success of stocking is uncertain.

ADULT SIZE: 25-47 mm SL.

BIOLOGY: Unstudied.

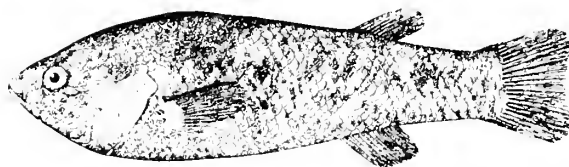
Compiler: D. S. Lee. June 1978.

Empetrichthys merriami Gilbert
Ash Meadows killifish

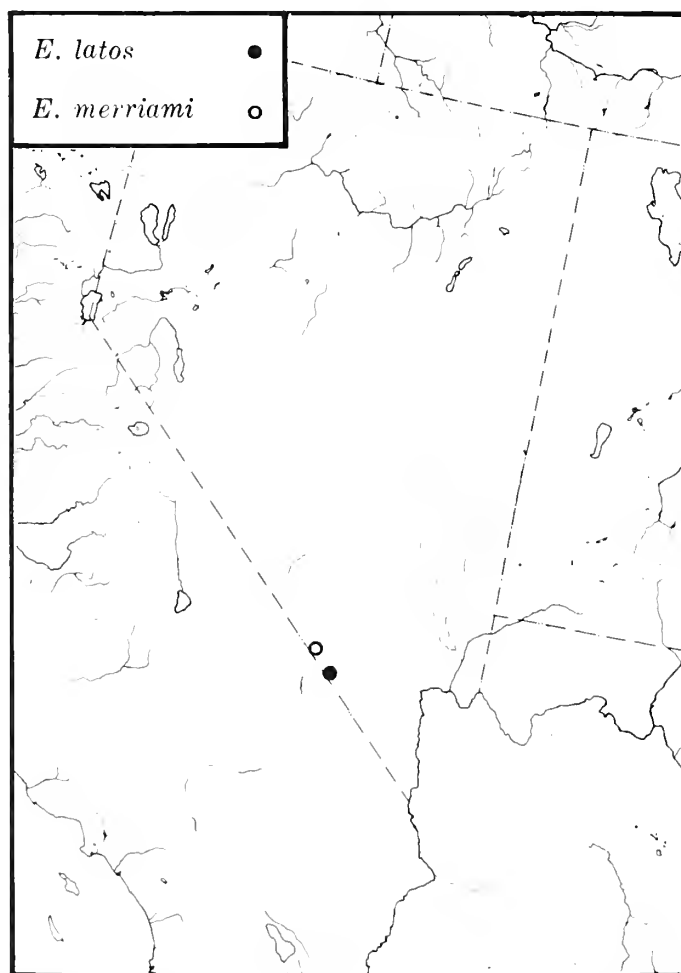
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Ash Meadows, Amargosa Desert, on boundary between CA and NV (Gilbert 1893. N. Am. Fauna 7:229-34). The precise locality in Ash Meadows is King Springs, Nye Co., NV (Shapovalov 1941. Proc. Sixth Pac. Sci. Congr. 3:441-46; Miller 1948. Misc. Publ. Mus. Zool. Univ. Mich. 68: 1-155).

SYSTEMATICS: One of two species in genus. Most closely related to *Crenichthys*. Miller (1948) reviewed genus and (1950. Evolution 4:155-63) discussed evolution and speciation. *Empetrichthys* probably derived from *Fundulus* (Garman 1895. Mem. Mus. Comp. Zool. 19:1-179; Miller 1948).



Boundary between CA and NV:
Ash Meadow, Amargosa Desert,
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: A thermal isolate known from five separated springs in Ash Meadows. La Rivers (1962. *Fishes and Fisheries of Nevada*) ascribed its rarity to competition with *Cyprinodon nevadensis*.

BIOLOGY: Apparently omnivorous (La Rivers 1962). Nothing else reported.

ADULT SIZE: 20-59 mm SL.

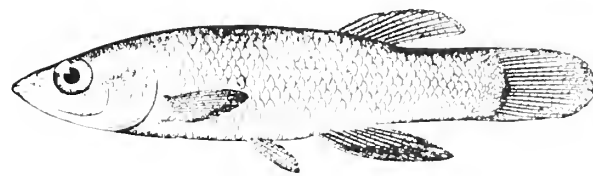
Compiler: D. S. Lee. June 1978.

Fundulus albolineatus Gilbert
Whiteline topminnow

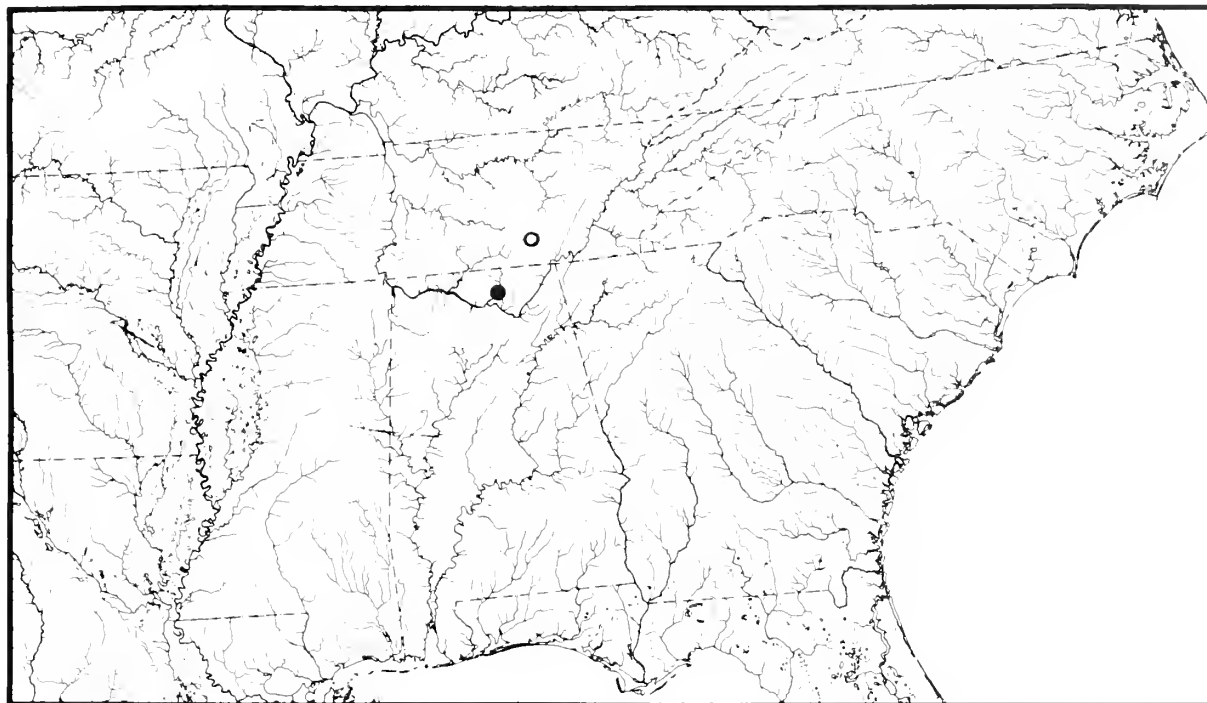
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Spring Creek, Huntsville, Madison Co., AL (Gilbert 1891. Bull. U.S. Fish Comm. [1889], 9:149-59).

SYSTEMATICS: Subgenus *Xenisma*. Spring Creek population regarded by some ichthyologists as specifically distinct from widely disjunct population of Tennessee and Cumberland river drainages (Duck and Caney Fork systems) in Coffee Co., TN (Ramsey 1976. Bull. Ala. Mus. Nat. Hist. 2:53-65). They appear to differ in color pattern and certain morphometric features.



AL: Spring Creek, Huntsville (Jordan and Evermann 1900).



Solid circle represents type locality of *F. albolineatus*; open circle represents area inhabited by undescribed form.

DISTRIBUTION AND HABITAT: Known only from type locality, where it apparently was restricted to spring habitat. No additional specimens from this area have since been collected. Thus, barring changes in present taxonomic interpretations of Tennessee population, species is considered extinct.

ADULT SIZE: ca. 84 mm maximum.

BIOLOGY: Nothing known.

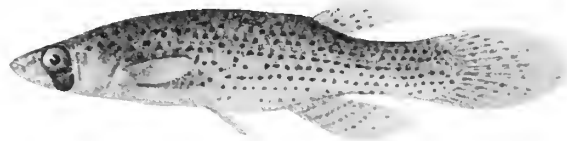
Compiler: J. R. Shute. February 1978.

Fundulus blairae Wiley and Hall
Blair's starhead topminnow

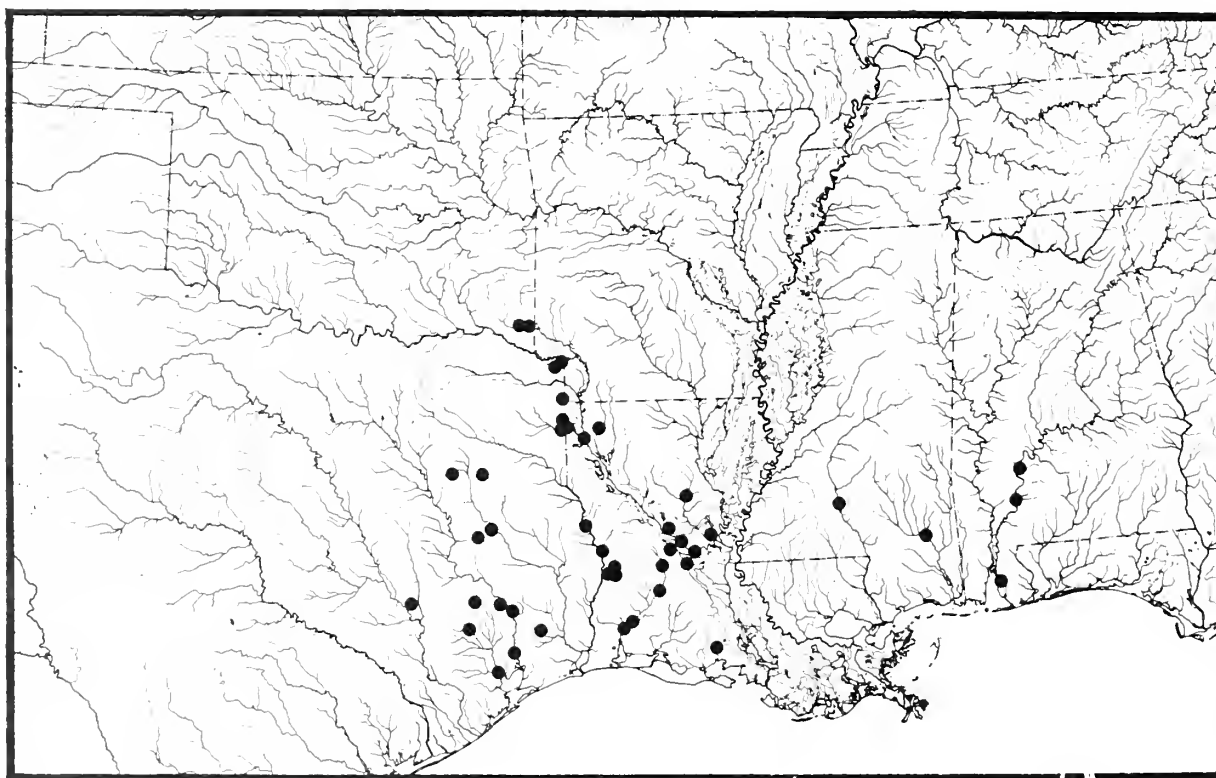
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Neville Bayou at Texas hwy. 105, Liberty Co., TX (Wiley and Hall 1975. Am. Mus. Novit. 2577:1-13).

SYSTEMATICS: Formerly considered western population of *F. notti* (Brown 1958. Am. Midl. Nat. 59:477-88). Thought to be most closely related to *F. dispar* (Wiley and Hall 1975; Wiley 1977. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 66:1-31).



(Garman 1895. Mem. Mus. Comp. Zool. 19:1-179)



DISTRIBUTION AND HABITAT: Middle Brazos River drainage, TX, north and east to southeastern OK (Wiley and Hall 1975) and southwestern AR (Robison 1977. Southwest. Nat. 23:544), east to lower part of Mobile Bay drainage, AL (Wiley 1977). Inhabits swamps, barrow ditches, sloughs, and streams with slow flow and heavy vegetation.

ADULT SIZE: 30-50 mm SL, ca. 65 mm maximum.

BIOLOGY: Apparently similar to *F. dispar*.

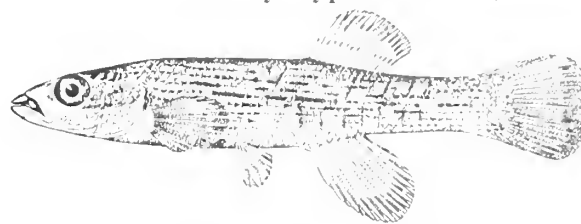
Compiler: E. O. Wiley. April 1979.

Fundulus catenatus (Storer)
Northern studfish

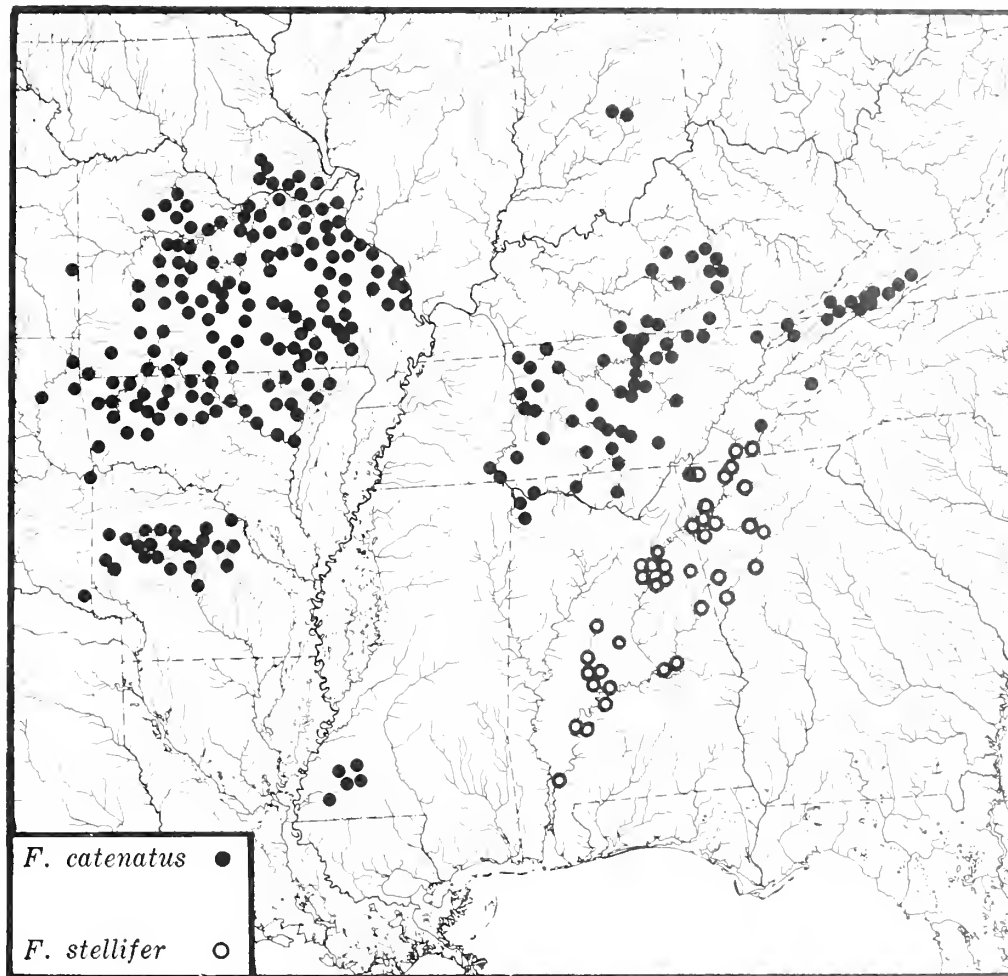
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Florence, Lauderdale Co., AL (Storer 1846. Mem. Am. Acad. Arts Sci. 2:253-550).

SYSTEMATICS: Subgenus *Xenisma*, Thomerson (1969. Tulane Stud. Zool. Bot. 16:1-21) reviewed the systematics of this species and the closely related *F. stellifer*.



TN: Ball Creek, male,
(Jordan and Evermann
1900).



Map modified from Thomerson 1969

DISTRIBUTION AND HABITAT: West of Mississippi River, primarily in Ozark and Ouachita mountains. East, largely in uplands of Tennessee, Cumberland, and Green river drainages, and with disjunct populations in Wabash drainage, IN, and certain direct eastern tributaries of Mississippi River, TN and MS. Recently discovered, highly localized populations in one headwater each of Salt and Kentucky river drainages, KY (Branson and Batch 1971. Am. Midl. Nat. 86:496-500). In streams of varying size with moderate to high gradients, permanent flow of clear water, and bottoms usually of sand, gravel, rock, and occasionally an admixture of silt. Usually common.

ADULT SIZE: 152-178 mm TL.

BIOLOGY: According to McCaskill et al. (1972. Trans. Am. Fish. Soc. 101:375-77), *F. catenatus* is mainly a bottom feeder, with a diet principally of insects and some molluscs. It breeds from mid-May to early August. No nest is prepared, but males establish and guard small territories in shallow, quiet waters (Pflieger 1975. *The Fishes of Missouri*).

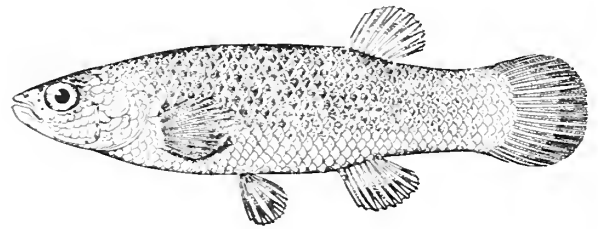
Compiler: J. R. Shute. March 1978.

Fundulus chrysotus (Günther)
Golden topminnow

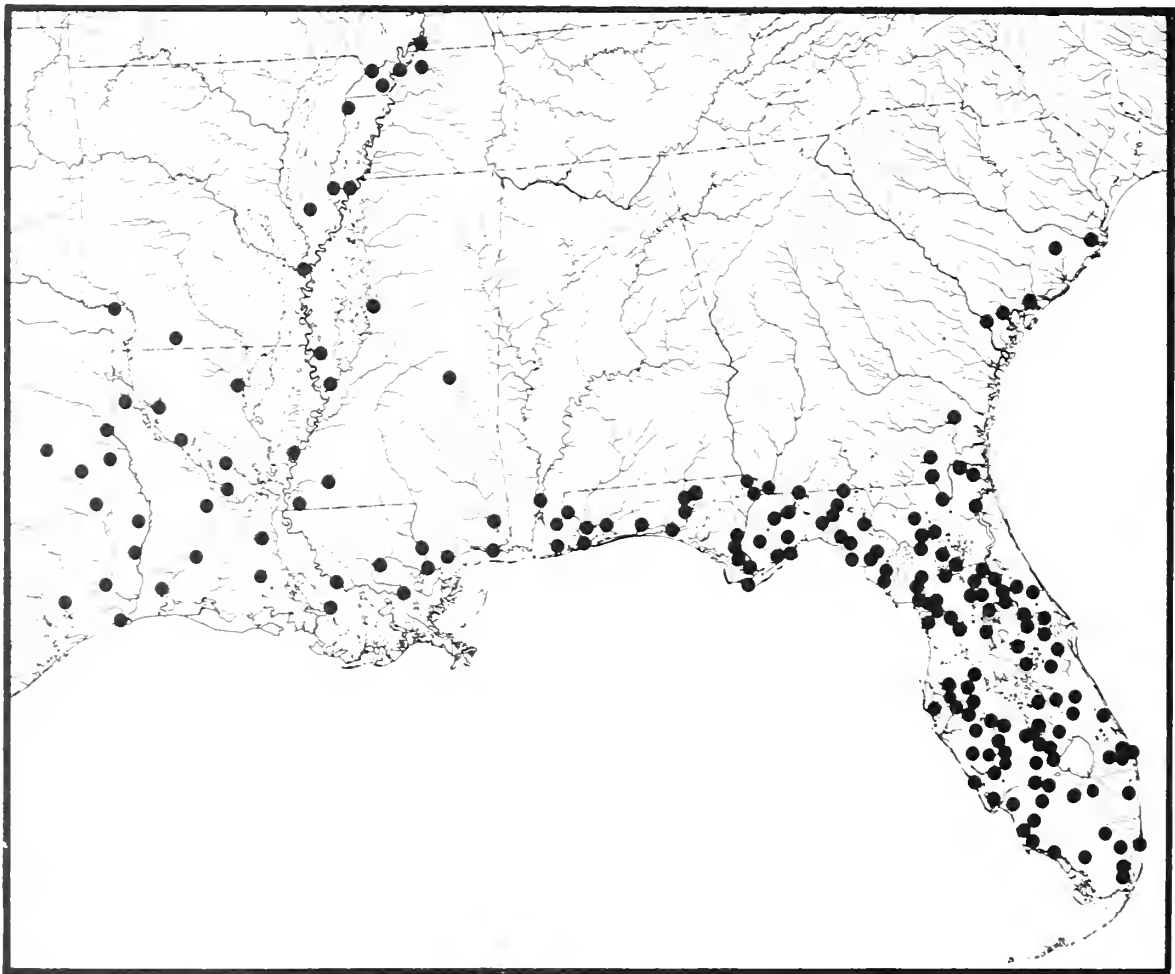
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Charleston, Charleston Co., SC (Günther 1866. *Catalogue of the Fishes in the British Museum* 6:1-368).

SYSTEMATICS: Subgenus *Zygonectes*. In past frequently confused with similar *F. cingulatus*. Brown (1956. *Copeia*:251-55) diagnosed and compared the two species and defined ranges.



FL: ca. 56 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Lowland areas (below Fall Line) from SC, GA, and FL west along Gulf to eastern TX and north to extreme southeastern MO and western KY. Inhabits backwaters and pools of ditches and slow-moving streams, usually associated with heavy submergent aquatic vegetation. Occasionally in brackish water along coast. Relatively common in preferred habitat throughout most of range.

ADULT SIZE: 30-50 mm SL, 57 mm SL maximum.

BIOLOGY: Feeds mainly on insects and other aquatic invertebrates, near or at the surface (Hunt 1953. *Trans. Am. Fish. Soc.* [1952] 82:13-33). Leitholf (1917. *Aquatic Life* 2:141-42) described reproductive activity in aquaria and noted that eggs were deposited on submerged plants, stones, and side of aquarium. Eggs laid a few at a time over period of a week or more. (Pflieger 1975. *The Fishes of Missouri*).

Compiler: J. R. Shute. September 1978.

Fundulus cingulatus Valenciennes
Banded topminnow

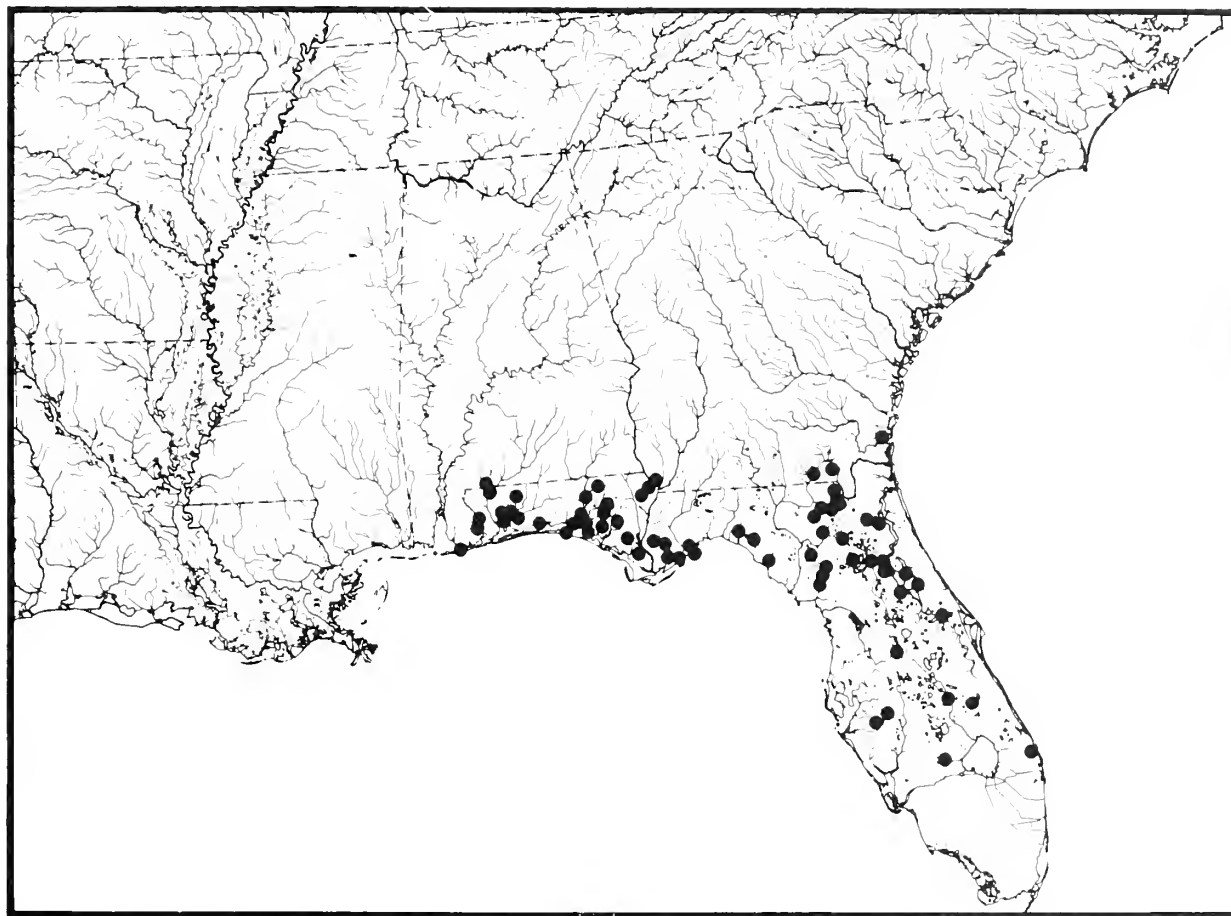
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: "United States" (Valenciennes in Cuvier and Valenciennes 1846. *Histoire Naturelle des Poissons* 18:1-505).

SYSTEMATICS: Although long recognized as valid (Miller 1955. *Occas. Pap. Mus. Zool. Univ. Mich.* 568:1-25) and correctly diagnosed by Hubbs (1926. *Misc. Publ. Mus. Zool. Univ. Mich.* 16:1-87), this species has consistently been confused with *F. chrysotus*. Brown (1956. *Copeia*: 251-55) clarified status and provided detailed comparison of the two species.



FL: Gulf Co., Cypress Creek,
65 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Almost entirely confined to FL, where found as far south as Tamiami Canal, Collier Co. (Brown 1956). Also occurs in extreme southeastern GA (St. Marys and Satilla river drainages) (FSM 6677) and ranges west nearly to lower Mobile Bay area, AL (Ramsey 1976. *Bull. Ala. Mus. Nat. Hist.* 2:53-65). Typically in backwater areas of sluggish lowland streams, swamps, and marshes, often in association with extensive aquatic vegetation. Seems to prefer somewhat shallower, more ephemeral situations than similar-appearing *F. chrysotus*. Sometimes common, but generally much more sporadically distributed than *F. chrysotus*.

ADULT SIZE: Up to at least 65 mm SL.

BIOLOGY: Foster (1967. *Stud. Trop. Oceanogr.* 5:549-66) indicated bottom-feeding, and remarked on certain aspects of reproductive behavior. Frequently ephemeral nature of habitat suggests that eggs may often survive and develop in dry substrate, as is true of various other cyprinodontid species.

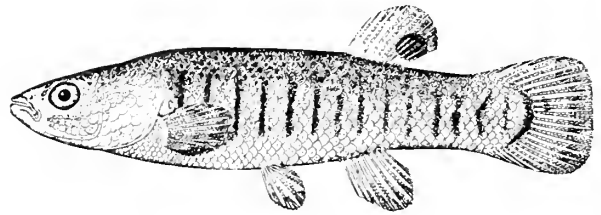
Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Fundulus confluentus Goode and Bean
Marsh killifish

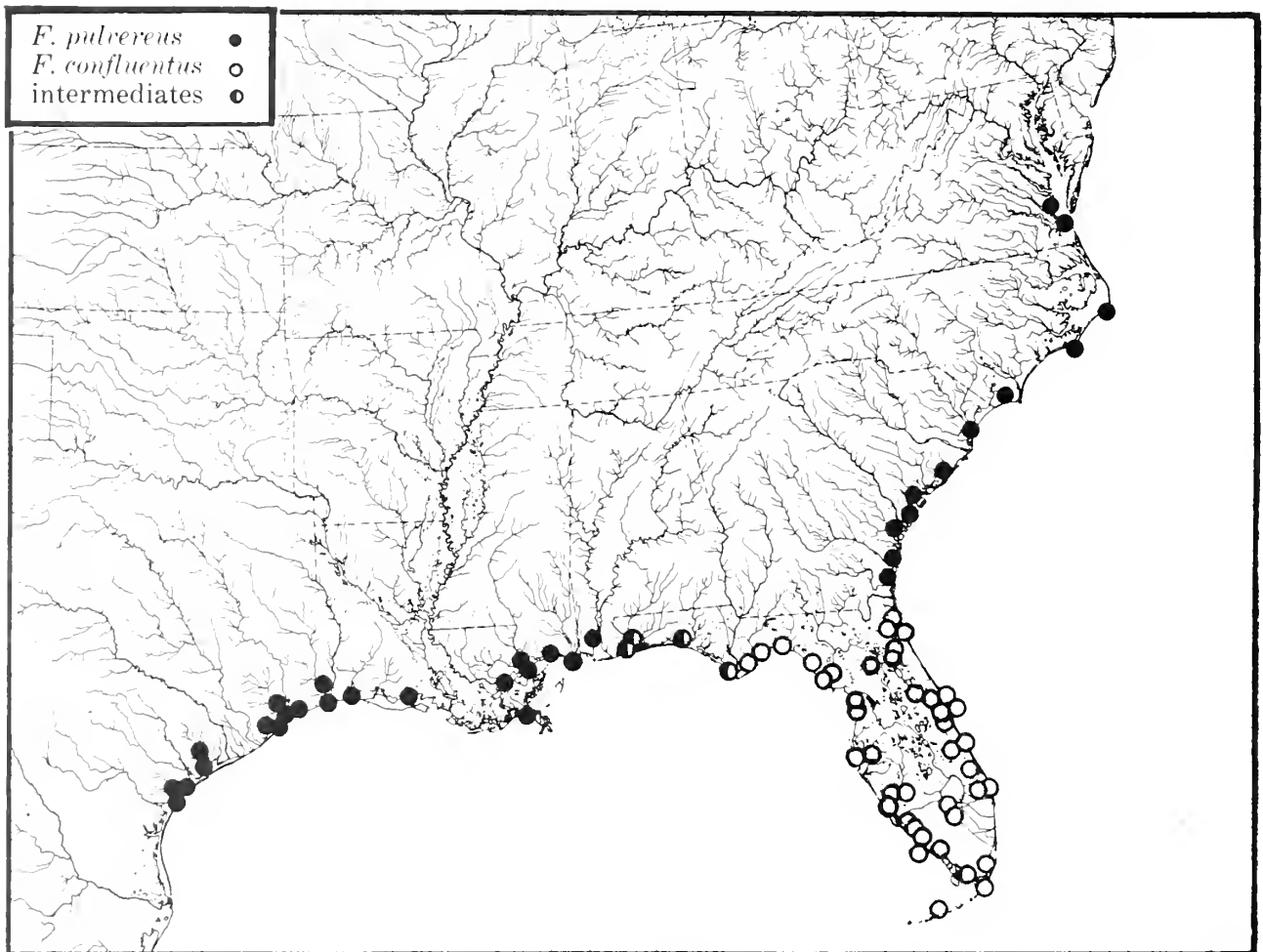
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Lake Monroe, FL (Goode and Bean in Goode 1880. Proc. U.S. Natl. Mus. [1879] 2:108-21).

SYSTEMATICS: Subgenus *Fundulus* (Rosen 1973. Suborder Cyprinodontoidei, in Mem. Sears Found. Mar. Res. 1 [6]:229-62). Relyea (1965. M.S. thesis, Florida State Univ.) presented strong evidence that *F. confluentus* and *F. pulvereus* are conspecific. Further study needed.



FL: Withlacoochee River, ca.
52 mm SL (Jordan and
Evermann 1900).



DISTRIBUTION AND HABITAT: If *F. confluentus* and *F. pulvereus* not conspecific, range of former limited to FL. Narrow zone of hybridization (or intergradation) with *F. pulvereus* in northeastern FL and much broader zone in western FL. Occurs in both fresh and brackish waters (maximum salinity 20.4 ppt) and has been collected in bayous, open pools in mangrove swamps, tidal streams, and freshwater rivers and streams.

BIOLOGY: Foods include larval and adult mosquitoes, shrimp, copepods, annelids, and plant material. Adhesive eggs typically deposited where some desiccation will occur, thereby delaying hatching. Early life history reviewed by Foster (1969. Ph.D. diss., Cornell Univ.) and Hardy (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 2).

ADULT SIZE: 81 mm TL maximum.

Compiler: J. D. Hardy, Jr. November 1979.

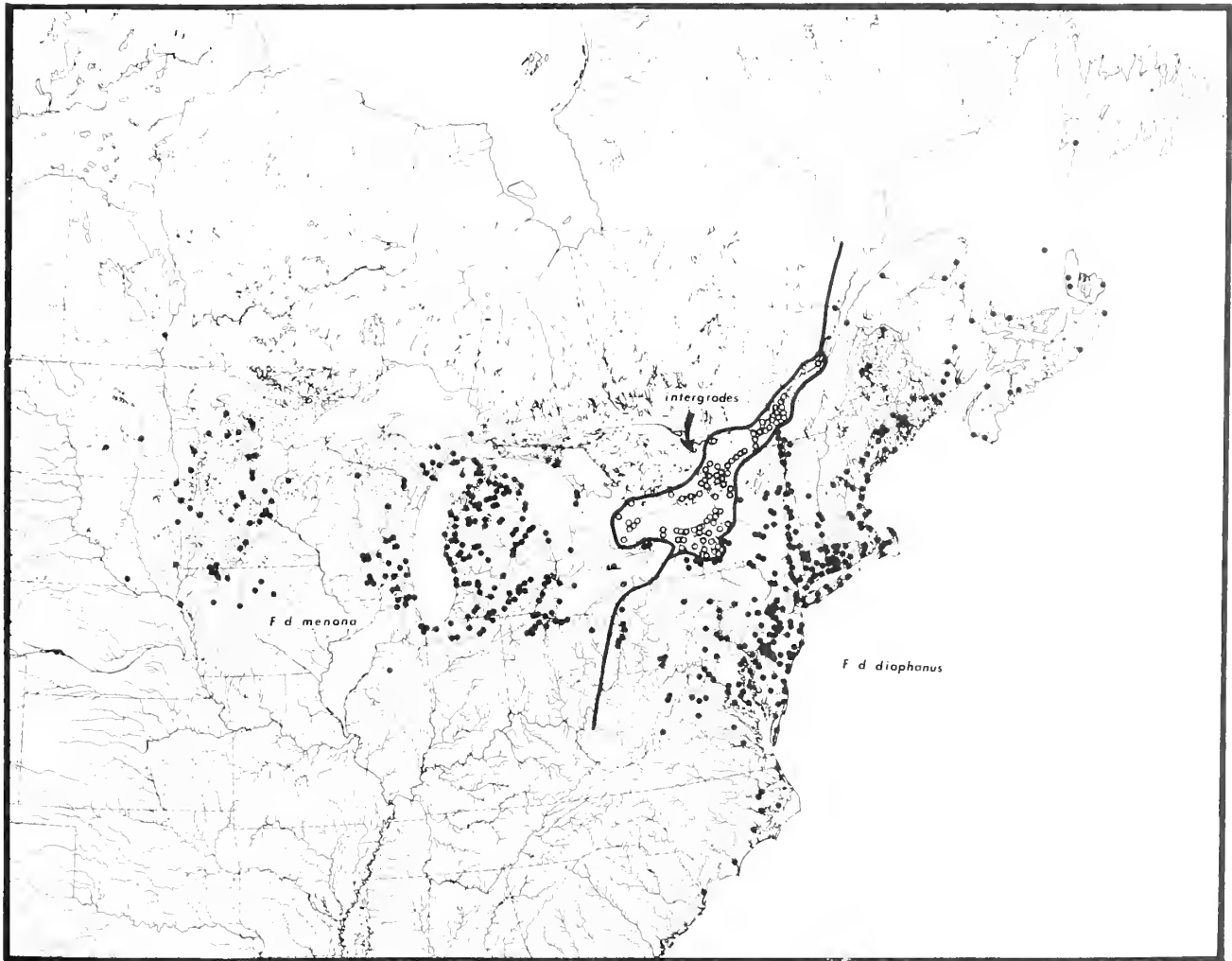
Fundulus diaphanus (Lesueur)
Banded killifish

Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Saratoga Lake, NY (Lesueur 1817. J. Acad. Nat. Sci. Phila: 126-34).

SYSTEMATICS: Shapiro (1947. Ph.D. diss., Univ. Michigan) studied systematics. Two subspecies recognized, *F. d. diaphanus* and *F. d. menona*. Hybridization, although rare, occurs with *F. heteroclitus* (Hubbs et al. 1943. Contrib. Lab. Vertebr. Biol. Univ. Mich. 23:1-21).

MD: Baltimore Co., Gunpowder River (NCSM).



DISTRIBUTION AND HABITAT: From coastal SC north to Maritime Provinces and NF, west through northern United States and southern Canada to Yellowstone River in eastern MT. Area of intergradation in western NY and eastern ON drainages. Prefers quiet waters of lakes, ponds, and sluggish streams having sand or gravel bottoms with patches of submergent vegetation. Often taken in estuaries in water salinities to 20 ppt.

ADULT SIZE: 50 mm-75 mm TL.

BIOLOGY: Male selects and courts female. Eggs released in clusters and have filaments for attachment to plants (Richardson 1939. Copeia:165-67). Versatile feeder, at all levels of water column despite superior position of mouth (Keast and Web 1966. J. Fish. Res. Board Can. 23:1845-67). Hoffman (1967. *Parasites of North American Freshwater Fishes*) listed parasites.

Compilers: C. R. Gilbert and J. R. Shute.
March 1978.

Fundulus dispar (Agassiz)
Northern starhead topminnow

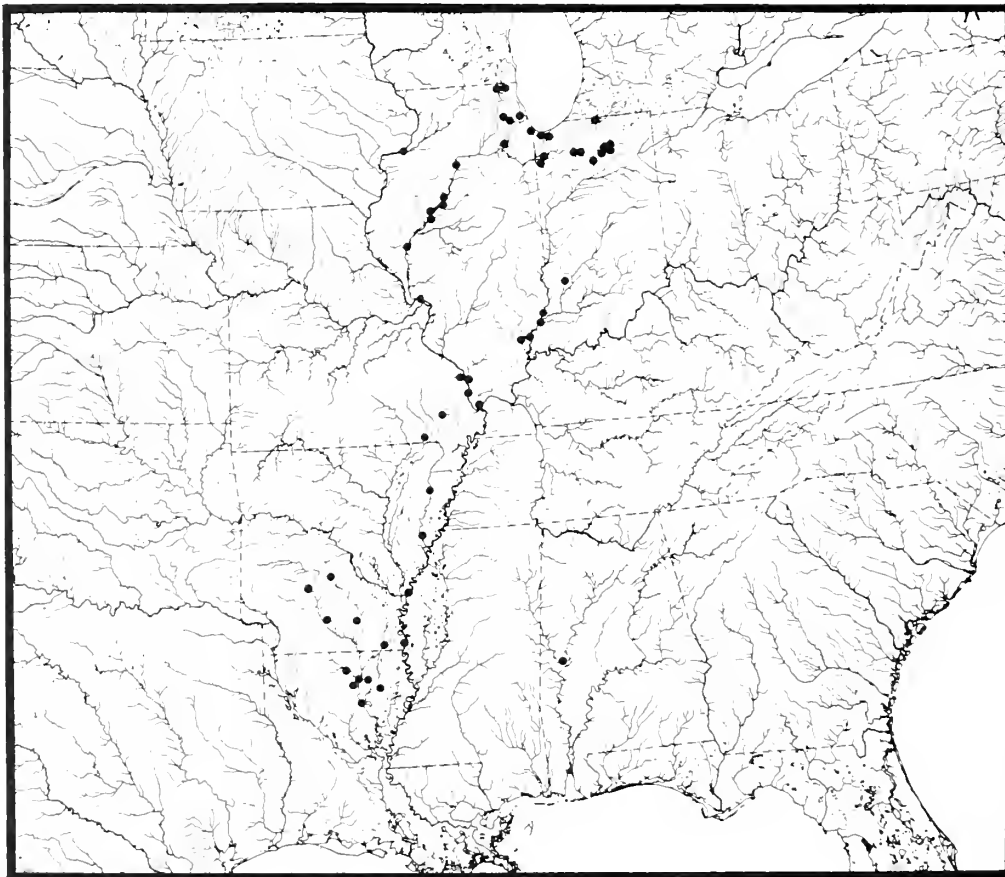
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: A stream in IL opposite St. Louis, MO (Agassiz 1854. Am. J. Sci. Arts 17:297-308, 353-65). A locality near Bearstown, IL, is also mentioned. Wiley and Winsor (ms.) plan to restrict type locality of the St. Louis vicinity locality.

SYSTEMATICS: Formerly considered subspecies of *F. notti* (Brown 1958. Am. Midl. Nat. 59:477-88). Griffith (1974. Copeia: 319-31), Wiley and Hall (1975. Am. Mus. Novit. 2577:1-13) and Wiley (1977. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 66:1-31) recognized *F. dispar* as distinct species. Thought to be most closely related to *F. blairae* (Wiley and Hall 1975; Wiley 1977).



(Garman 1895. Mem. Mus. Comp. Zool. 19:1-179).



DISTRIBUTION AND HABITAT: Ouachita River drainage, LA (Wiley and Hall 1975), and in upper Mobile Bay drainage, AL (Wiley 1977), and north to MI (Brown 1958). Commonly inhabits swamps, marshes, well-vegetated ponds and lakes, and small streams (Smith 1979. *Fishes of Illinois*).

BIOLOGY: Breeds in early spring in dense vegetation (Smith 1979). Diet includes aquatic insects, snails, crustaceans, and algae (Gunning and Lewis 1955. Ecology 36:552-58).

ADULT SIZE: 30-50 mm SL, ca. 65 mm maximum.

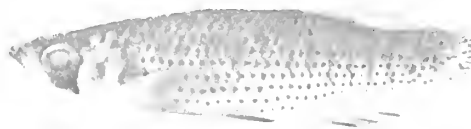
Compiler: E. O. Wiley. April 1979.

Fundulus escambiae (Bollman)
Eastern starhead topminnow

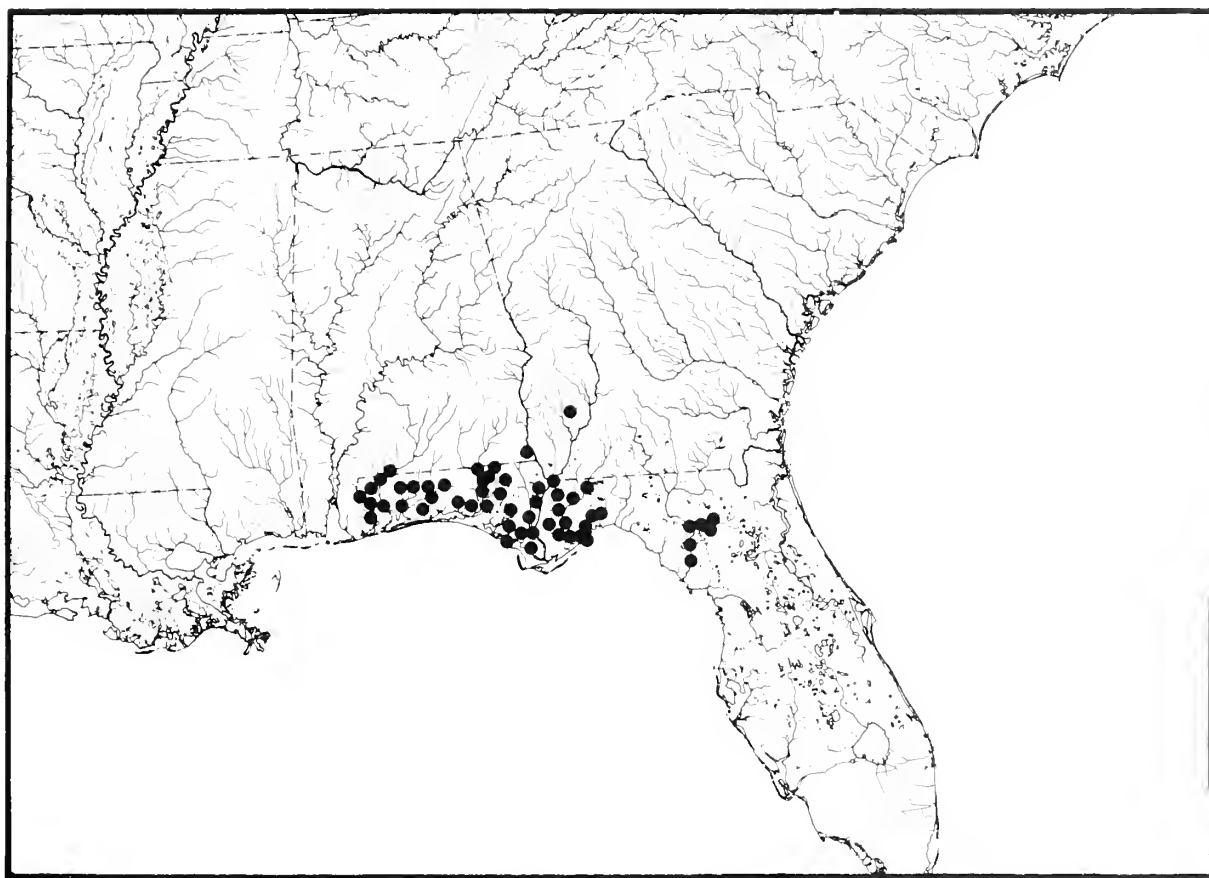
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Tributary of Escambia River, Flomaton, AL (Bollman 1887. Proc. U.S. Natl. Mus. 9:462-65).

SYSTEMATICS: Formerly considered conspecific with *F. notti* and not accorded subspecific status (Brown 1958. Am. Midl. Nat. 59:477-88), but recognized as distinct by Wiley (1977. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 66:1-31). Most closely related to *F. notti*. Much geographic variation in color pattern throughout range.



Choctawhatchee River drainage,
male, 52 mm SL (Wiley 1977).



DISTRIBUTION AND HABITAT: From Perdido River drainage, AL and FL, east below Fall Line to lower Suwannee River drainage, FL (Wiley 1977). Rivas' (1966. Copeia:353-54) report of sympatry between *F. lineolatus* and *F. "notti"* refers to *F. lineolatus* and *F. escambiae*. Inhabits fresh waters and is common in backwaters, sloughs, barrow ditches, and streams with moderate to slow flow.

ADULT SIZE: Commonly 35-45 mm SL, ca. 65 mm maximum.

BIOLOGY: Little known. Probably similar to *F. dispar*.

Compiler: E. O. Wiley. April 1979.

Fundulus grandis Baird and Girard
Gulf killifish

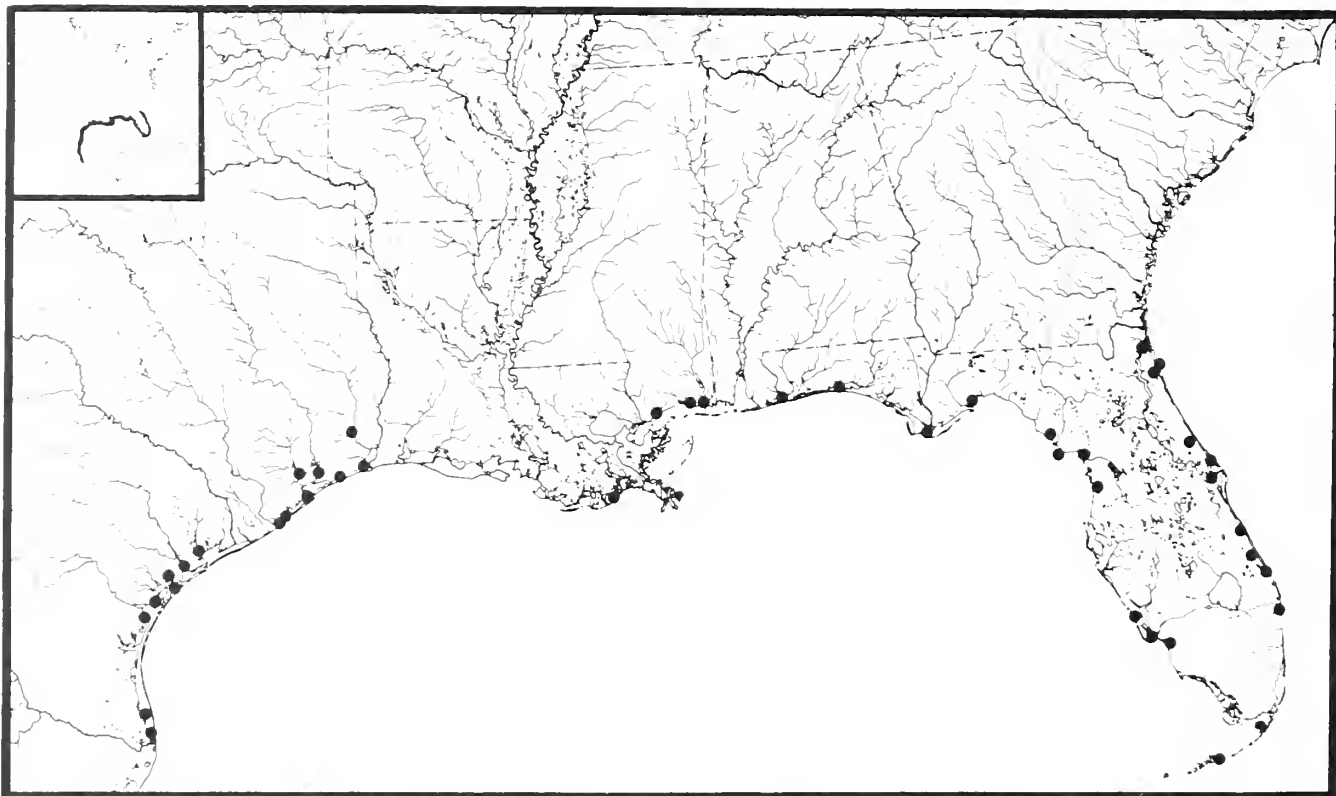
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Indianola, TX (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. [1852-53] 6:387-90).

SYSTEMATICS: Relyea (in press. Bull. Florida State Mus. Biol. Sci.) reviews systematics and recognizes two subspecies, *F. g. grandis* and *F. g. saguanus*. Closest relative is *F. heteroclitus*. Species also addressed in Rivas (1948. Proc. U.S. Natl. Mus. 98:215-21), Gosline (1949. Occas. Pap. Mus. Zool. Univ. Mich. 519:1-17), Miller (1955. Occas. Pap. Mus. Zool. Univ. Mich. 568:1-25), Simpson and Gunter (1956. Tulane Stud. Zool. 4:115-34), and Brown (1957. J. Wash. Acad. Sci. 47:69-77).



FL: Brevard Co., Merritt Island, 38 mm SL (NCSM).



DISTRIBUTION AND HABITAT: *Fundulus g. grandis* ranges from mouth of St. Johns River, FL, to Laguna de Tamiahua, Veracruz, Mexico, but is absent from lower tip of peninsular FL, FL Keys, and Tortugas, where replaced by *F. g. saguanus* (which also occurs in Cuba). Common along bay shores and tidal marshes in wide range of salinities, from fresh water (Tabb and Manning 1961. Bull. Mar. Sci. Gulf Carib. 11:552-648) to 76 ppt. (Simpson and Gunter 1956).

ADULT SIZE: 70 - 138 mm TL.

BIOLOGY: Griffith (1974. Copeia: 2:319-31) studied salinity tolerances and had 88% survival in fresh water after one month. Daily rhythms of plasma chloride described by

Meier et al. (1973. Copeia: 1:90-92) and Spence et al. (1977. Copeia: 3:557-66). Feeds on fishes, aquatic insects, and vegetable matter (Simpson and Gunter 1956). Spawning season apparently varies according to locale, possibly year-round (Kilby 1955. Tulane Stud. Zool. 2:175-247; Joseph and Yerger 1956. Fla. State Univ. Stud. Biol. Sci. 2:111-56; Springer and Woodburn 1960. Fla. State Board Conserv. Prof. Pap. Ser. 1:1-104). Spawning behavior described by Relyea (in press); eggs yellow, adhesive, 2 mm in diameter (Simpson and Gunter 1956). Schools less than some estuarine *Fundulus* species, but often seen in feeding groups of 12-20 (Relyea, in press).

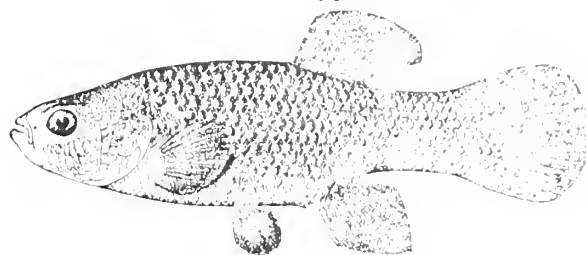
Compilers: G. H. Burgess and J. R. Shute. June 1979.

Fundulus heteroclitus (Linnaeus)
Mummichog

Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Charleston, Charleston Co., SC (Linnaeus 1766, *Systema Naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532).

SYSTEMATICS: A number of subspecies described, but only two recognized by Scott and Crossman (1973, *Freshwater Fishes of Canada*): *F. h. heteroclitus* and *F. h. macrolepidotus*. Closest relative is *F. grandis*, with which it occurs sympatrically in northeastern FL.



MD: St. George Island, male,
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: *Fundulus h. heteroclitus* ranges from northeastern FL to VA and *F. h. macrolepidotus* from VA to Gulf of St. Lawrence and southern NF. Hybridizes with *F. diaphanus* (Hubbs et al. 1943, Contrib. Lab. Vertebr. Biol. Univ. Mich. 23:1-21). Relyea (in press, Fla. State Mus. Biol. Sci.) is reviewing this and related species. Common in salt marsh flats, estuaries, and tidal creeks, especially where there is abundant submergent and emergent vegetation. Occasionally enters freshwater streams and rivers.

ADULT SIZE: ca. 76-102 mm TL, 130 mm TL maximum.

BIOLOGY: Spawns in spring and summer, but commencement and duration significantly affected by temperature (Brummett 1966, Copeia:616-20). Courtship was described by Newman (1907, Biol. Bull. [Woods Hole] 12:314-45). No nest is constructed. Hoffman (1967, *Parasites of North American Freshwater Fishes*) listed parasites.

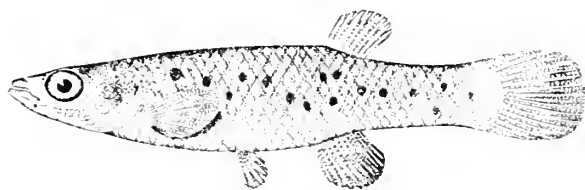
Compiler: J. R. Shute, February 1978.

Fundulus jenkinsi (Evermann)
Saltmarsh topminnow

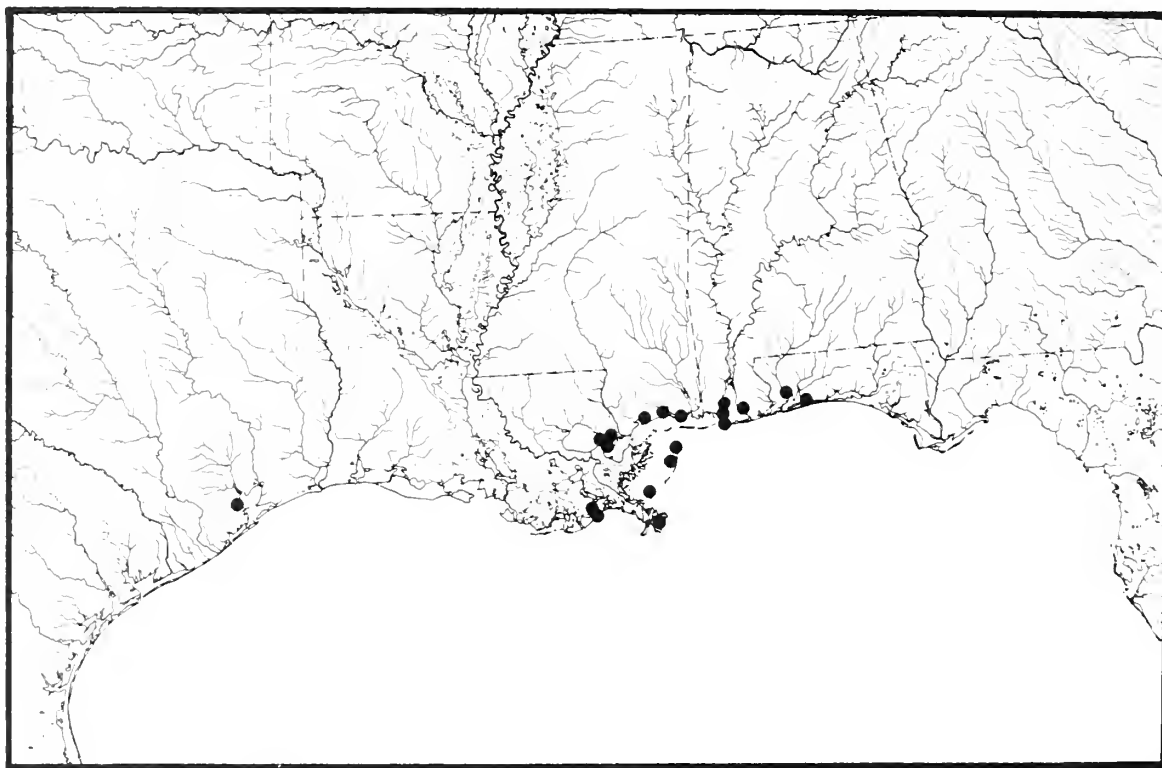
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Dickinson Bayou near Dickinson, TX (Evermann 1892. Bull. U.S. Fish. Comm. [1891] 11:61-90).

SYSTEMATICS: Presently considered member of subgenus *Zygonectes* (Brown 1957. J. Wash. Acad. Sci. 47:69-77; Rosen 1973. Suborder Cyprinodontoidei in Mem. Sears Found. Mar. Res. 1[6]:229-62), but ongoing studies indicate no close relationships with other listed members of subgenus.



TX: Dickinson Bayou, near Galveston, ca. 42 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Occurs sporadically along Gulf Coast from Galveston Bay, TX, eastward to Escambia Bay, FL. Seems to prefer salinities below 20 ppt and present studies indicate it is most abundant in *Spartina* marsh at 1 to 4 ppt in small, shallow tidal meanders.

ADULT SIZE: 35-45 (rarely to 60) mm SL.

BIOLOGY: Little known. Simpson and Gunter (1956. Tulane Stud. Zool. 4:113-34) gave egg size as .25 to .5 mm. Virtually no color in life and little sexual dimorphism other than median fin length. Examination of males collected between December and March revealed no indication of contact organs.

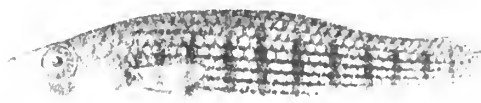
Compiler: B. A. Thompson. May 1979.

Fundulus lineolatus (Agassiz)
Lined topminnow

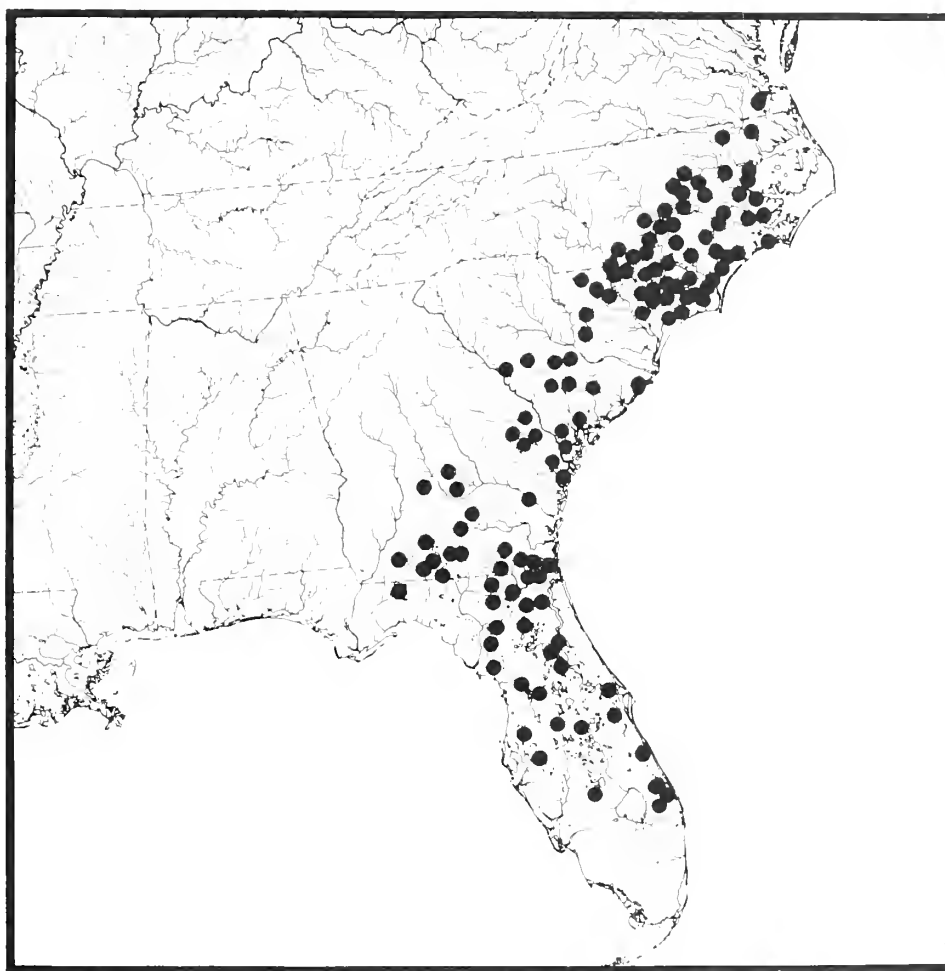
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: "Vicinity" of Augusta, GA (Agassiz 1854. Am. J. Sci. Arts 17: 297-308, 353-65).

SYSTEMATICS: Considered subspecies of *F. notti* (Brown 1958. Am. Midl. Nat. 59: 477-88) until Rivas (1966. Copeia:353-54) elevated it to species status based on sympatry with *F. notti* (= *F. escambiae*) (Wiley 1977. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 66:1-31). Considered by Wiley (1977) to be closely related to *F. notti* - *F. escambiae* species pair.



(Garman 1895. Mem. Mus. Comp. Zool. 19:1-179).



DISTRIBUTION AND HABITAT: Ocklockonee River drainage, FL and GA (Swift et al. 1977. Tall Timbers Res. Sta. Misc. Publ. 20:1-111), south to Dade Co., FL (Relyea 1975. Sci. Biol. J. 1:49-53), and north along Coastal Plain to southern VA (Brown 1958). Found in clear streams, backwaters, and ponds. Where sympatric with *F. escambiae*, tends to inhabit upper reaches of drainage while *F. escambiae* inhabits lower reaches (Swift et al. 1977).

ADULT SIZE: 30-55 mm SL, ca. 70 mm maximum.

BIOLOGY: Little known.

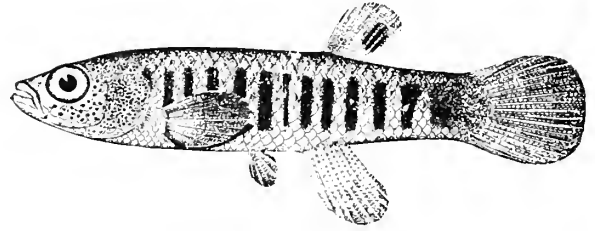
Compiler: E. O. Wiley, April 1979.

Fundulus luciae (Baird)
Spotfin killifish

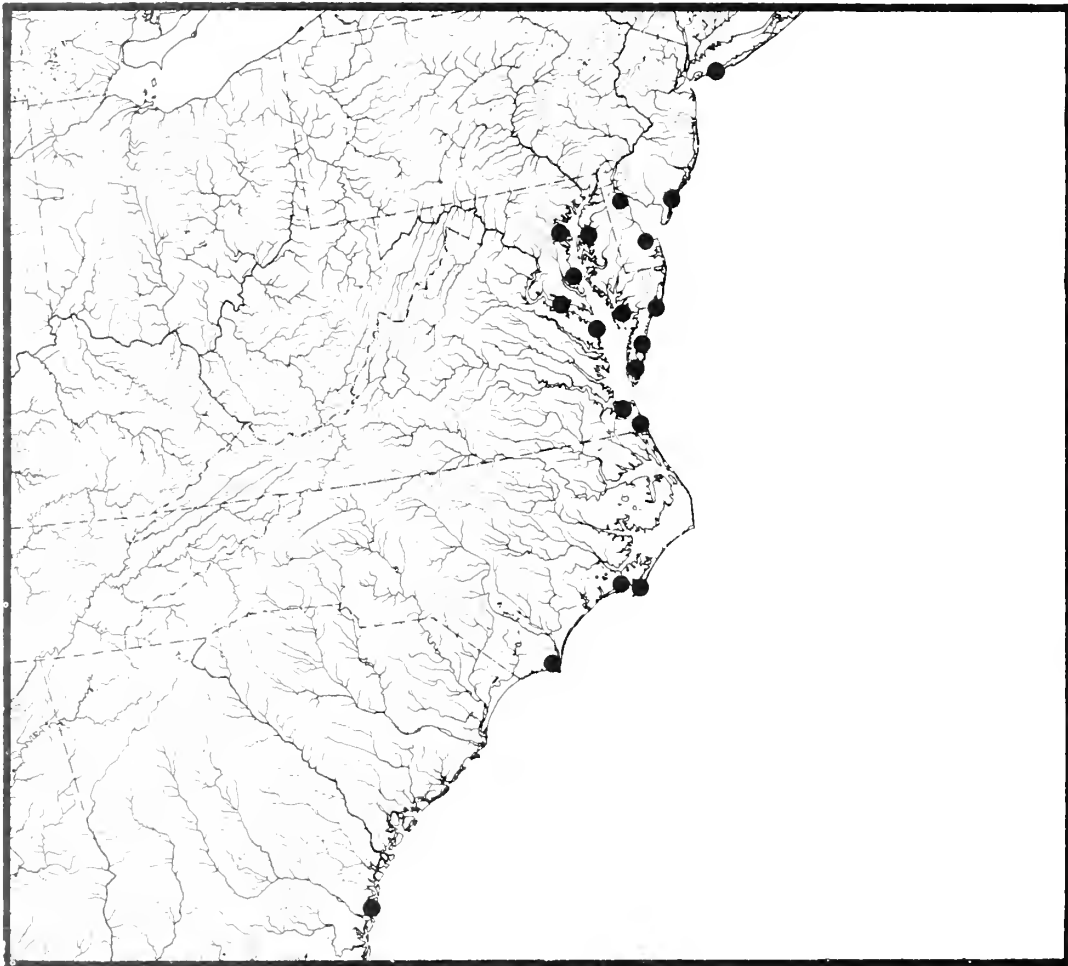
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Small ditch at Robinson's landing, Peck's beach opposite Beesely's Point, Cape May Co., NJ (Baird 1855. Ninth Smithson. Rep. [1854]:317-52).

SYSTEMATICS: Subgenus *Zygonectes*. Superficially resembles *Fundulus confluentus*. No detailed systematic study published.



MD: St. George Island (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Sporadically from Long Island (Butner and Brattstrom 1960. Copeia:139-41) south to GA (Jorgenson 1969. Chesapeake Sci. 10:65). Most populations seem to be concentrated in Chesapeake Bay, Delmarva region. Usually uncommon to rare, but occasionally common. Estuarine; typically in salt marshes. Richards and Bailey (1967. Chesapeake Sci. 8: 204-05) described habitat in VA and found salinities ranged from 0.4-27.8 ppt. Fowler (1913. Proc. Acad. Nat. Sci. Phila. 65:61-65) recorded it from freshwater ponds in MD and VA.

ADULT SIZE: 20-36 mm SL.

BIOLOGY: Limited information, mostly on habitat and water salinity, provided by Hildebrand and Schroeder (1928. *Fishes of Chesapeake Bay*), Crawford (1920. Aquatic Life 5:75-76), and Richards and Bailey (1967). Kneib (1978. Copeia:164-68) provided data on diet, reproduction, and growth.

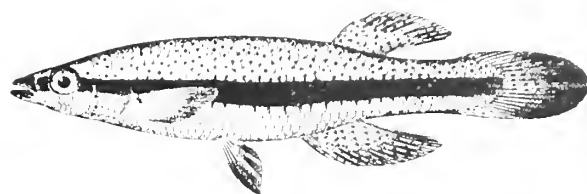
Compiler: D. S. Lee. April 1978.

***Fundulus notatus* (Rafinesque)**
Blackstripe topminnow

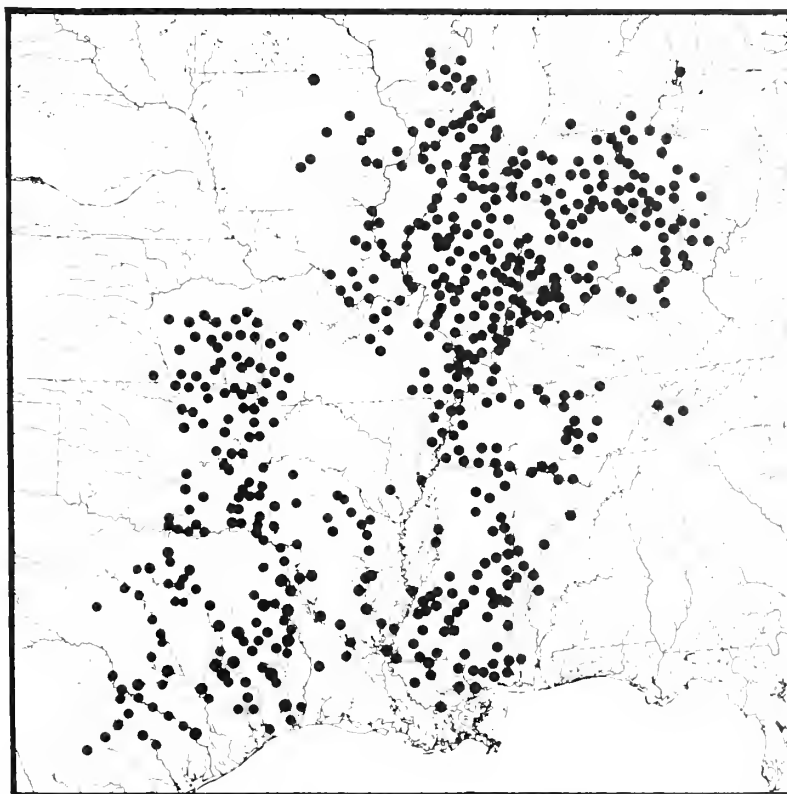
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Brazos River, at Well River and Little River, KY (Rafinesque 1820. *Ichthyologica Ohicensis*).

SYSTEMATICS: Subgenus *Zygonectes*. Regarded by Hubbs and Burnside (1972. *Copeia*: 862-65) as distinct genus. Most closely related to *F. olivaceus* (Braasch and Smith 1965. *Copeia*: 46-53; Thomerson 1966. *Tulane Stud. Zool.* 13:29-47) and an apparently undescribed species from Tangipahoa River, MS and AL. Setzer (1970. *Trans. Am. Fish. Soc.* 99: 139-46) reported a basic difference in diploid chromosome number between *F. notatus* (40) and *F. olivaceus* (48) throughout respective ranges, but Black and Howell (1978. *Copeia*: 20-88) found a race of *F. notatus* in upper Tombigbee River system, AL and MS, with 44 pairs.



AR: White River, Eureka Springs (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Gulf slope, from Mobile Bay drainage in western AL west to San Antonio Bay drainage, TX; Mississippi Valley north to IA and southern WI; and Lake Michigan and Lake Erie drainages from WI to OH and ON. Prefers small to large, lowland, low-gradient streams and sloughs having water of moderate to high turbidity. Range highly complementary to that of *F. olivaceus*, which normally occupies cleaner, faster-flowing streams with firmer substrates. Usually common, but never collected in large numbers.

ADULT SIZE: 50-70 mm TL, 74 mm TL maximum.

BIOLOGY: Feeds at surface, usually from late morning to early evening. Terrestrial insects comprise nearly 50 percent of diet, the rest divided between aquatic insects, crustaceans, snails, and algae. In MI, spawns between May and August. Weakly defined and elastic territories defined by both sexes (Carranza and Winn 1954. *Copeia*: 273-78). Three age groups recognized by Nieman and Wallace (1974. *Am. Midl. Nat.* 92:203-05). Young-of-the-year grow rapidly during first summer, attaining mean length of 40.7 mm TL (Nieman and Wallace 1974).

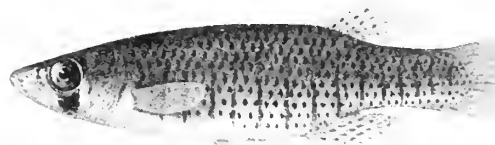
Compiler: J. R. Shute. January 1979.

Fundulus notti (Agassiz)
Starhead topminnow

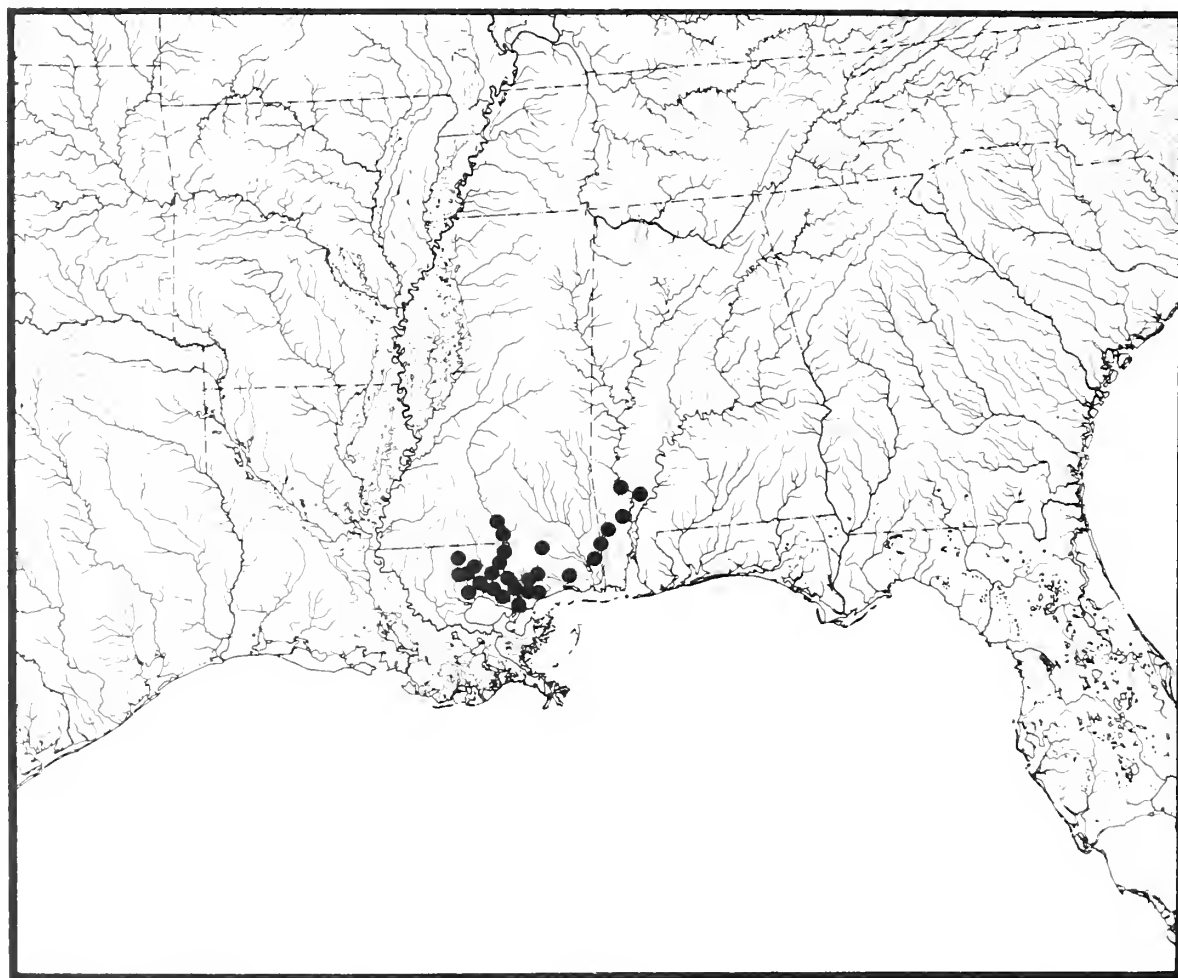
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Vicinity of Mobile, AL (Agassiz 1854. Am. J. Sci. Arts 17:297-308, 353-65).

SYSTEMATICS: Formerly considered wide-ranging species with several subspecies (Brown 1958. Am. Midl. Nat. 59:477-488). Closely related to *F. escambiae* (Wiley 1977. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 66:1-31).



(Garman 1895. Mem. Mus. Comp. Zool. 19:1-179).



DISTRIBUTION AND HABITAT: Lower parts of Mobile Bay drainage west below Fall Line to Lake Pontchartrain drainage, LA. Distributional records outside range given probably pertain to other species of *F. notti* species complex (Wiley 1977). Common in backwaters, sloughs, bayous, borrow ditches, and streams with moderate to slow flow. Generally more in open areas than other associated killifish, such as *F. chrysotus*. Usually common.

ADULT SIZE: 30-50 mm SL, maximum 65 mm.

BIOLOGY: Nothing published. Presumably similar to that noted for other closely related forms in the species complex.

Compiler: E. O. Wiley. April 1979.

Fundulus olivaceus (Storer)
Blackspotted topminnow

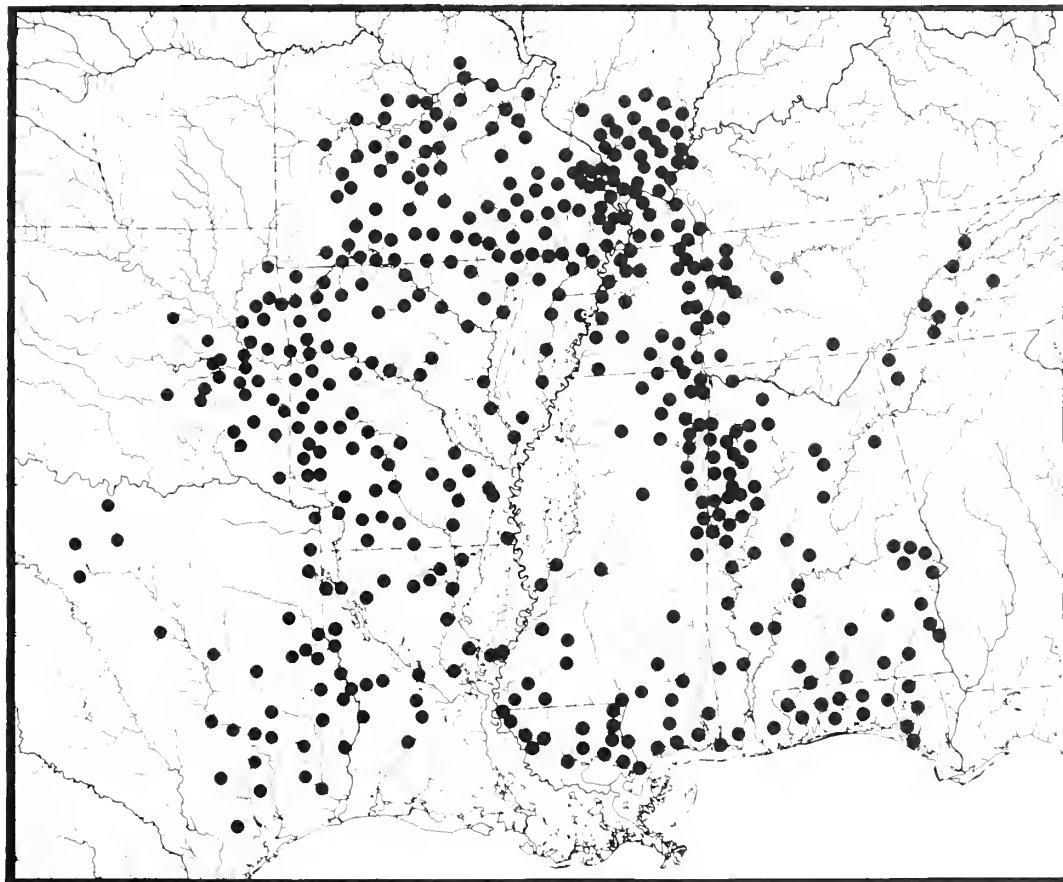
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Florence, Lauderdale Co., AL (Storer 1845. Proc. Boston Soc. Nat. Hist. 2:47-49).

SYSTEMATICS: Subgenus *Zygionectes*. Regarded by Hubbs and Burnside (1972. Copeia: 862-65) as distinct genus. Most closely related to *F. notatus* (Braasch and Smith 1965. Copeia: 46-53; Thomerson 1966. Tulane Stud. Zool. Bot. 13:29-47) and an apparently undescribed species from Tangipahoa River, MS and LA. Setzer (1970. Trans. Am. Fish. Soc. 99:139-46) reported basic difference in diploid chromosome number between *F. notatus* (40) and *F. olivaceus* (48) throughout respective ranges, but Black and Howell (1978. Copeia: 280-88) found race of *F. notatus* in upper Tombigbee River system, AL and MS, with 22 pairs.



LA: Lincoln Parrish, Ouachita River drainage, 45 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Gulf slope, from Galveston Bay drainage, TX, east to Choctawhatchee River system, FL, and middle Chattahoochee River drainage, GA; north in Mississippi Valley to central MO and southern IL, and east to eastern TN. Prefers small to large fast-flowing, relatively clear, sand-gravel bottom streams where often occurs along margins near thick stands of emergent vegetation. Common but rarely collected in large numbers.

ADULT SIZE: 60-90 mm TL, 97 mm TL maximum.

BIOLOGY: Food habits discussed by Rice (1942. J. Tenn. Acad. Sci. 17:4-13), and further studies on biology by Thomerson (1966).

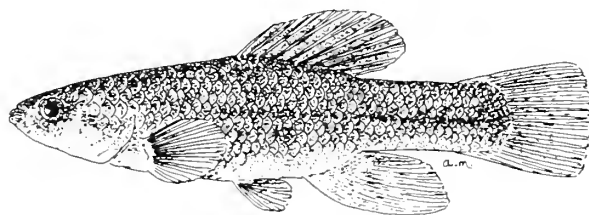
Compiler: J. R. Shute. March 1978.

Fundulus parvipinnis Girard
California killifish

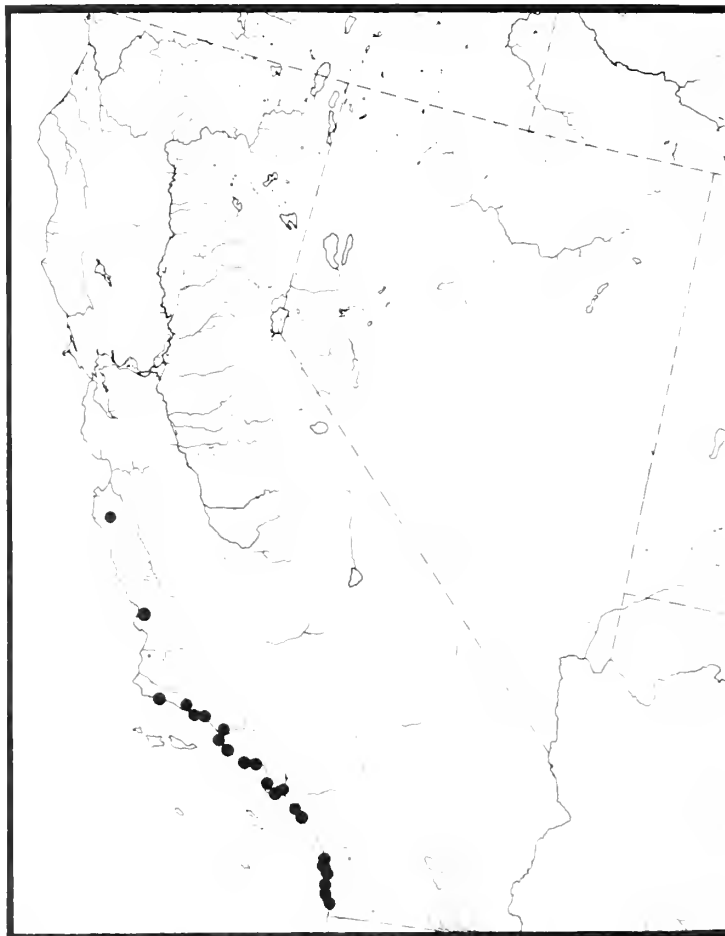
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: San Diego, San Diego Co., CA (Girard 1856. Proc. Acad. Nat. Sci. Phila. [1854-55] 7:142-56).

SYSTEMATICS: Closely related to *F. lima* of southern Baja California (Miller 1943. Copeia:51-52). *Fundulus p. brevis* generally not recognized (Follett 1960. Syst. Zool. 9: 212-32), but listed as valid by Hubbs et al. (1979. Occas. Pap. Calif. Acad. Sci. 133: 1-51).



CA: San Luis Obispo Co., Los Osos Creek, 75 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Lagoons, bays, and estuaries from Morro Bay, CA, south to Magdalena Bay, Baja California. One reported from Monterey Bay (possibly introduced) in lower Salinas River (Miller and Lea 1972. Calif. Fish Game Fish Bull. 157:1-235; Moyle 1976. *Inland Fishes of California*). Marine to fresh waters of protected bays and marshes, with tendency to invade freshwater in southern CA and northern Baja California (Moyle 1976).

BIOLOGY: Tolerates hypersaline conditions up to 128 ppt. Breeds May to August (Moyle 1976). Daily movements synchronized with tides, moving into shallow flats with high tide. Lives about 18 months with 3% of population to 30 months. Breeds June to November. Food mostly arthropods with few annelids, gastropods, and fish eggs (Fritz 1977. Calif. Dept. Fish Game Fish Bull. 165:91-106).

ADULT SIZE: 50-90 mm SL.

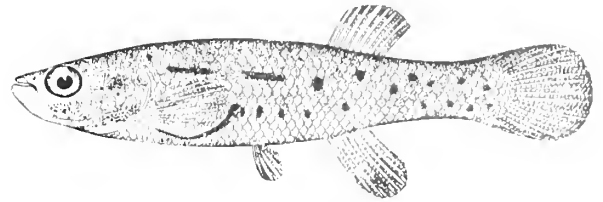
Compiler: C. C. Swift. January 1979.

Fundulus pulvereus (Evermann)
Bayou killifish

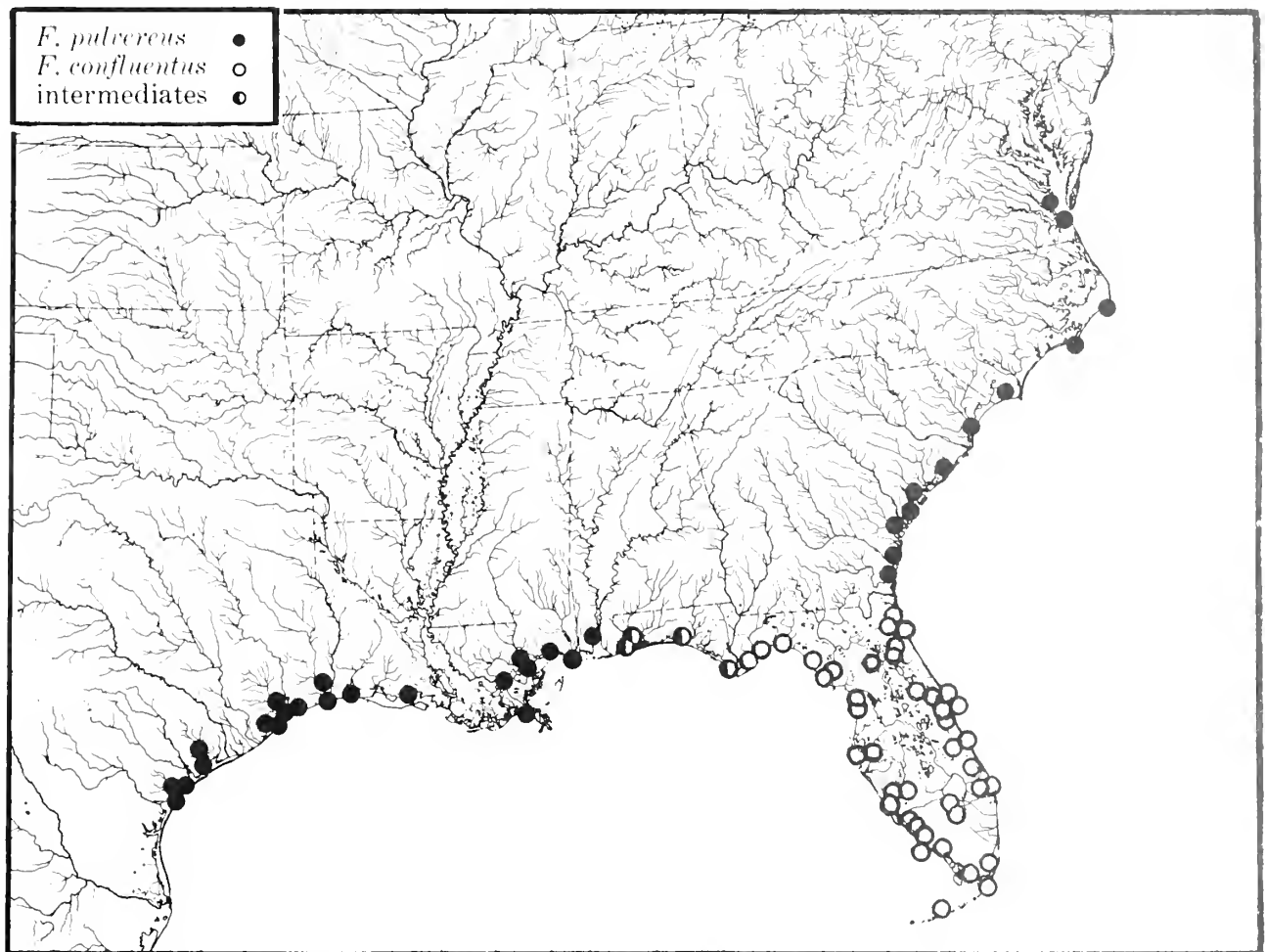
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: No holotype designated. Type series from Dickinson Bayou, Dickinson, TX; Buffalo Bayou, Houston, TX; and Oso Creek, Corpus Christi, TX (Evermann 1892. Bull. U.S. Fish Comm. [1891] 11:61-90).

SYSTEMATICS: Subgenus *Fundulus* (Rosen 1973. Suborder Cyprinodontoidae in Mem. Sears Found. Mar. Res. 1[6]:229-62). Relyea (1965. M.S. thesis, Florida State Univ.) presented strong evidence that *F. pulvereus* is subspecies of *F. confluentus*. Further study needed.



TX: Dickinson Bayou, near Galveston, ca. 41 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: If valid species, range extends from Corpus Christi, TX, to Mobile, AL, on Gulf Coast and from St. John's River, FL, to lower York River, VA, on Atlantic slope. Wide zone of hybridization (or intergradation) on Gulf Coast and narrow zone in northeastern FL. Habitat includes brackish marshes, bayous, freshwater rivers, and rice fields on Gulf Coast, and barrier beach ponds on Atlantic slope.

ADULT SIZE: 65 mm TL maximum.

BIOLOGY: Foods include aquatic insects and isopods. Spawns in fall on Gulf Coast, and ripe individuals observed in March. Foster (1969. Ph.D. diss., Cornell Univ.) reviewed early life history. Drewry (1967. Ph.D. diss., Univ. Texas) presented data on sound production and hybridization with other cyprinodontids.

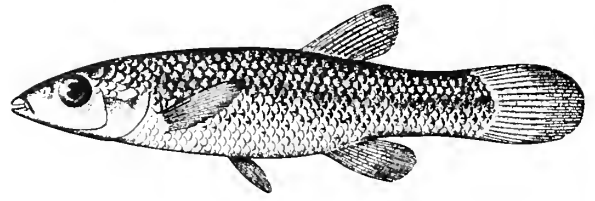
Compiler: J. D. Hardy, Jr. November 1979.

Fundulus rathbuni Jordan and Meek
Speckled killifish

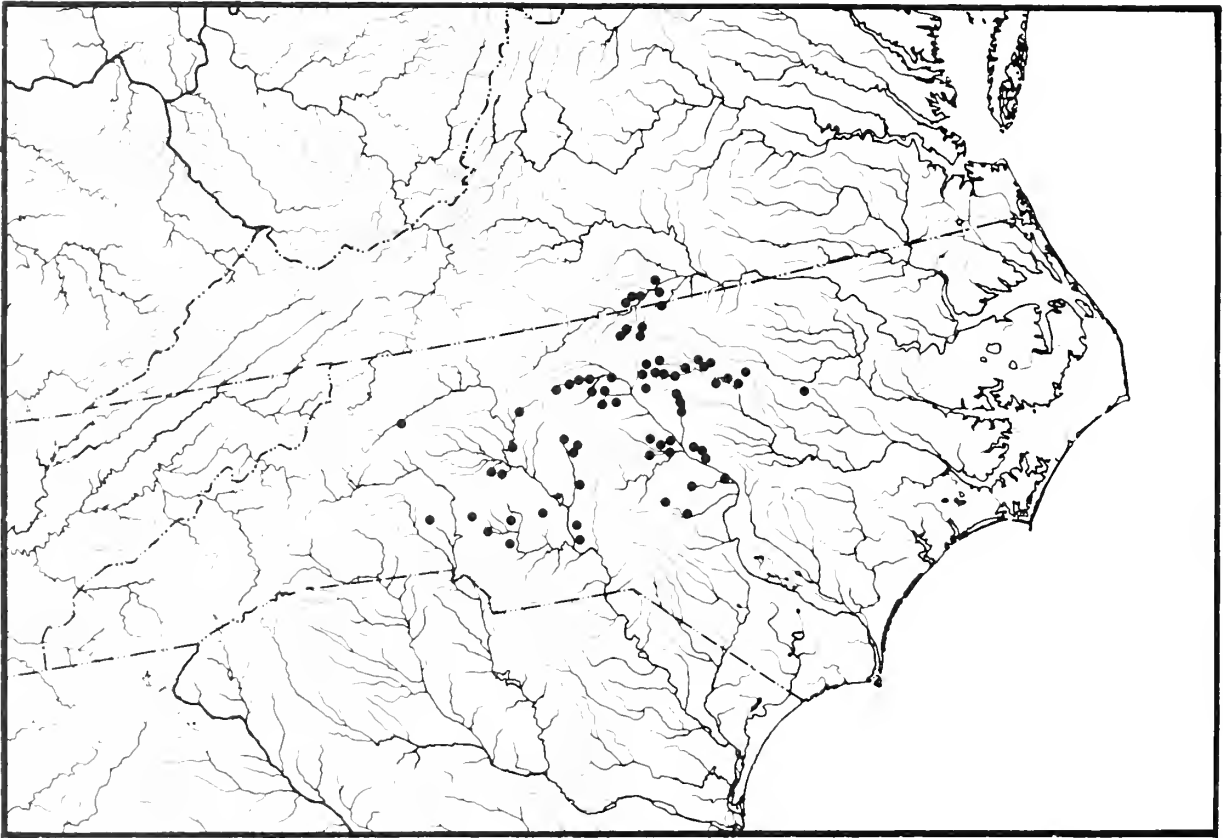
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Not restricted; lectotype apparently not designated. Syntypes from Reedy Fork and other tributaries of Cape Fear River, NC, and jumping Run n of Salisbury, Yadkin River, NC (Jordan and Meek in Jordan 1889. Proc. U.S. Natl. Mus. 11 [1888]: 351-62).

SYSTEMATICS: Brown (1955. J. Elisha Mitchell Sci. Soc. 71:207-13) studied morphologic variation and phylogenetic relationships; showed considerable geographic variation and concluded that it belonged in subgenus *Xenisma* with *F. stellifer* and *F. catenatus*.



NC: Alamance Creek, ca.60 mm SL (Jordan and Evermann 1900).



DISTRIBUTION: Piedmont and upper Coastal Plain portions of Roanoke, Neuse, Cape Fear, Pee Dee, and Santee drainages, VA and NC. Known only from Catawba system, Santee, and Dan system in Roanoke drainage. Apparently absent from Tar drainage, between Roanoke and Neuse. Often common in quiet parts of streams, usually over mud or sand bottom.

ADULT SIZE: 40 - 80 mm SL.

BIOLOGY: No previously published information available. Young of year collected on 1 August averaged 14 mm SL. Those of 29 September averaged 21 mm SL. Most individuals probably do not reach sexual maturity until second year. Smallest female examined with full term eggs was 41.5 mm SL. Females collected in spring had approximately 300 eggs in three size classes. Protracted spawning season extends from at least mid-May through July. Bottom feeder. Known foods include pupae of chironomid midges and water boatmen, stonefly nymphs, and dytiscid beetles. A 15 mm *Notropis* recovered from one stomach.

Compiler: D. S. Lee, August 1978.

Fundulus sciadicus Cope
Plains topminnow

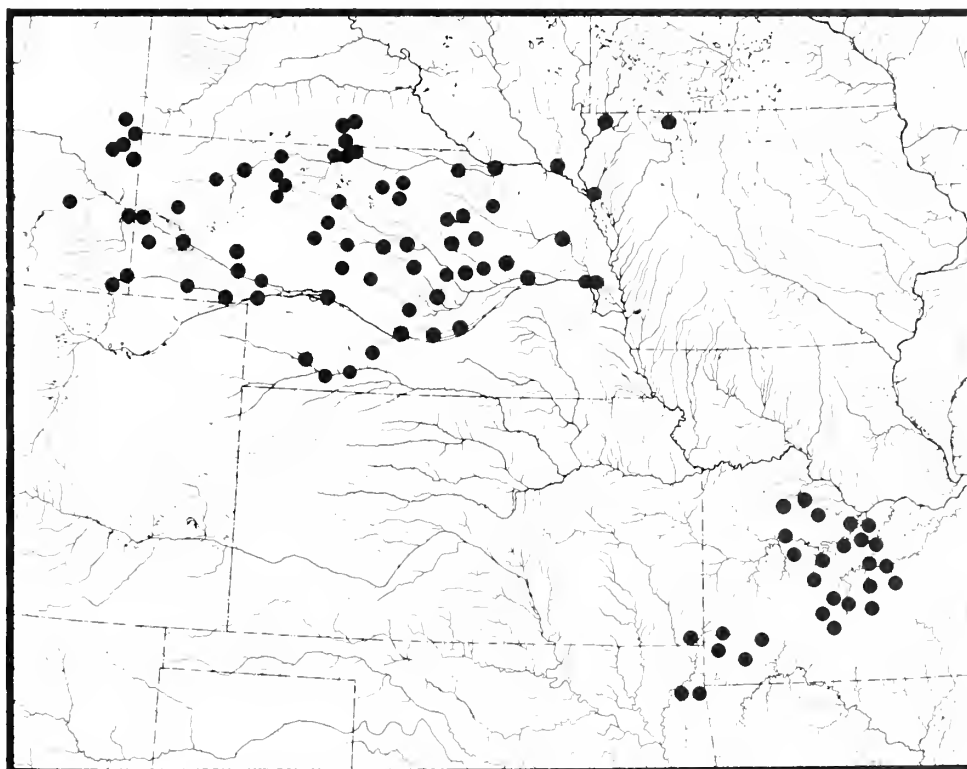
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Platte River, NB (Cope 1865. Proc. Acad. Nat. Sci. Phila. 17:78-88).

SYSTEMATICS: Chen (1971. Chromosoma 32:436-53), based on chromosomal characters, considered this species most closely related to *F. chrysotus*, *F. cingulatus*, *F. luciae*, and *F. uotii* complex. Provisionally considered sister species of *F. chrysotus* by Wiley and Hall (1975. Am. Mus. Novit. 2577:1-13).



MO: Wright Co., Gasconade River (Mo. Dept. Cons.).



DISTRIBUTION AND HABITAT: Apparently disjunct, with two main centers of distribution: one, primarily in NB, includes closely adjacent areas in north-eastern CO, eastern WY, southern SD, and northwestern IA; second, centered in south-central MO. includes extreme southeastern KS and extreme northeastern OK. Typically inhabits small to medium-sized, clear, sandy to rocky streams with moderate to rapid current; also may occur in quiet pools and backwaters. Often abundant, particularly in NB.

ADULT SIZE: ca. 38-64 mm TL, ca. 70 mm TL maximum.

BIOLOGY: Food habits not studied. Spawns in May and June in MO; eggs deposited on aquatic plants or algae, hatch in 8-10 days at about 21°C (Pflieger 1975. *The Fishes of Missouri*).

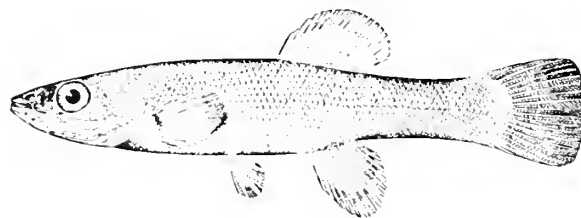
Compiler: J. R. Shute. October 1979.

Fundulus seminolis Girard
Seminole killifish

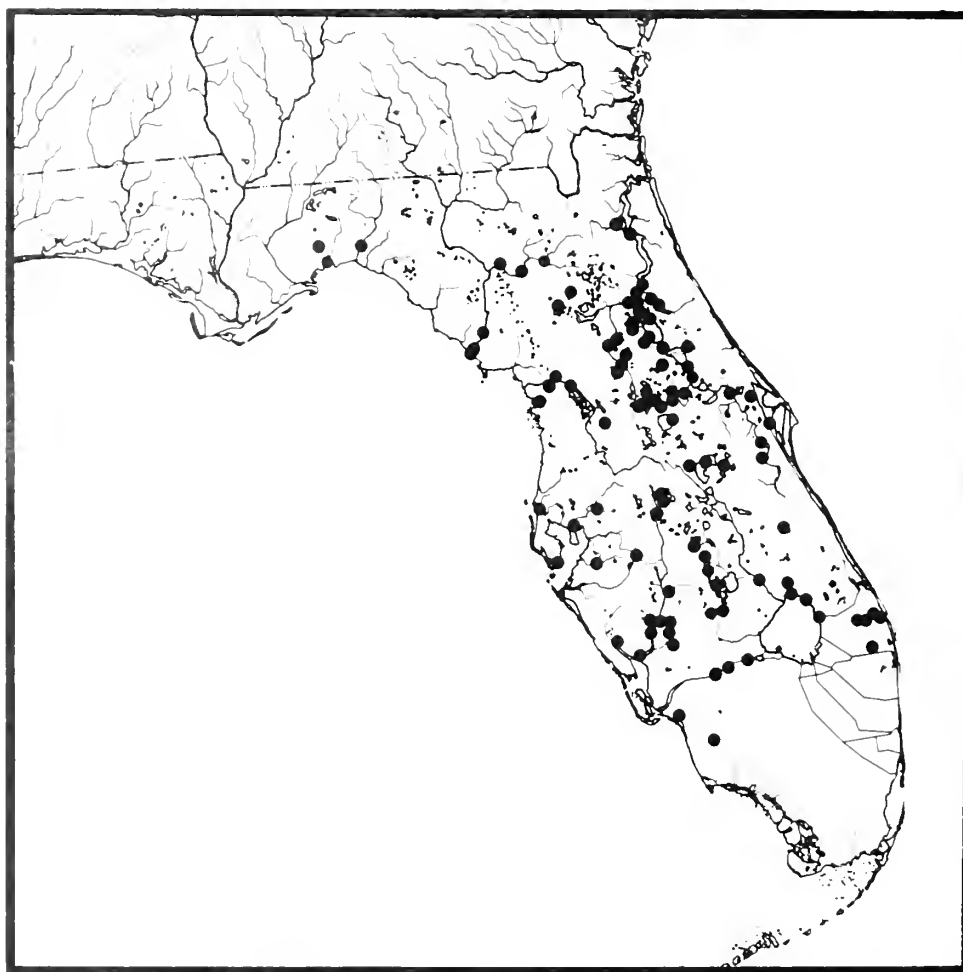
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Palatka, Putnam Co., FL (presumably from St. Johns River) (Girard 1860. Proc. Acad. Nat. Sci. Phila. 11: 56-68).

SYSTEMATICS: No systematic study of species yet published, although K. Relyea and R. W. Yerger have manuscript in preparation. Precise phylogenetic relationships to other *Fundulus* uncertain.



FL: Charlie Apopka Creek
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Endemic to peninsular FL, where ranges from New River (first drainage east of Apalachicola River) south throughout all but lowermost part of peninsula. Adults typically in open areas of streams and lakes, where they swim in small schools over sandy bottom. Juveniles more closely associated with floating or submergent vegetation.

ADULT SIZE: 90-160 mm TL.

BIOLOGY: Durant et al. (1979. Am. Midl. Nat. 102:127-33) studied biology. Spawns mainly in April or May, with some spawning activity throughout rest of summer. Feeds primarily on bottom-associated invertebrates, such as ostracods, cladocerans, and chironomid larvae. Swims either in mid-water or close to bottom, unlike most other *Fundulus* species which are usually found just under surface. Lives maximum of two years.

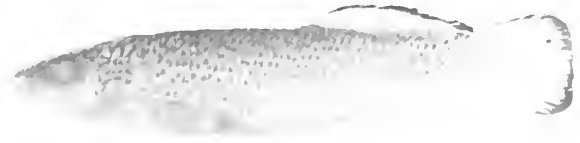
Compiler: C. R. Gilbert. August 1979.

Fundulus stellifer (Jordan)
Southern studfish

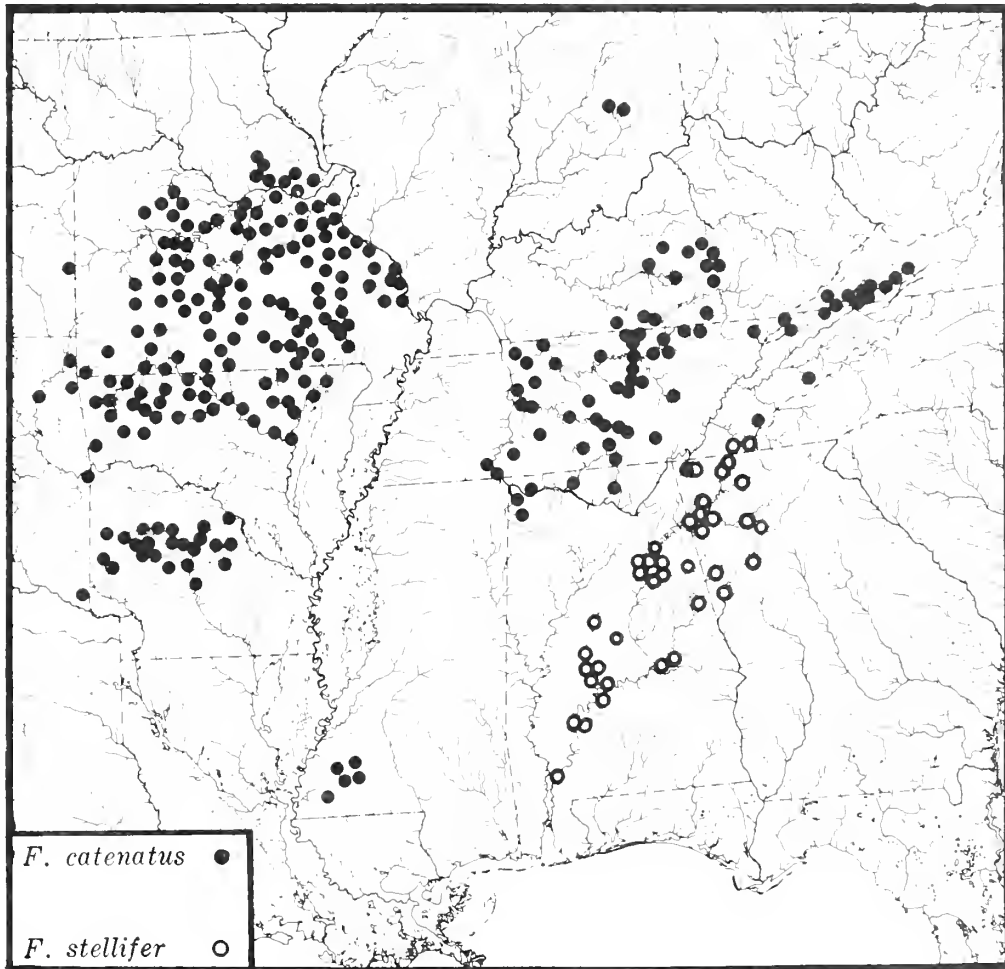
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Tributaries of Etowah, Oostanaula, and Coosa rivers, GA. Most specimens from Silver, Lavender, and Rocky creeks (Jordan 1877, Ann. N. Y. Lyceum Nat. Hist. 11:307-77).

SYSTEMATICS: Subgenus *Xenisma*. Thomerson (1969, Tulane Stud. Zool. Bot. 16:1-21) reviewed the systematics of this species and the closely related *F. catenatus*, and states *F. stellifer* may have evolved from a *F. catenatus*-like ancestor isolated in the Alabama River system.



AL: Wilcox Co., male, 59 mm
SL (Smith-Vaniz 1968).



Map modified from Thomerson 1969

DISTRIBUTION AND HABITAT: Restricted to streams in the Alabama and Chattahoochee river systems of GA and AL. Also recorded from a Tennessee River tributary in northwestern GA where it was presumably introduced (Thomerson 1969). Found in clear streams with sand and gravel bottoms. Usually less common than *F. catenatus*.

BIOLOGY: Thomerson (1969) summarized information on life history and reported that it feeds principally on snails, in contrast to *F. catenatus* which feeds primarily on insects.

ADULT SIZE: 59-100 mm SL.

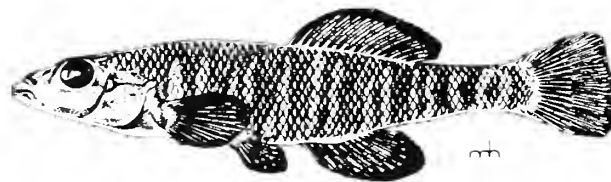
Compiler: J. R. Shute, March 1978.

Fundulus waccamensis Hubbs and
Raney
Waccamaw killifish

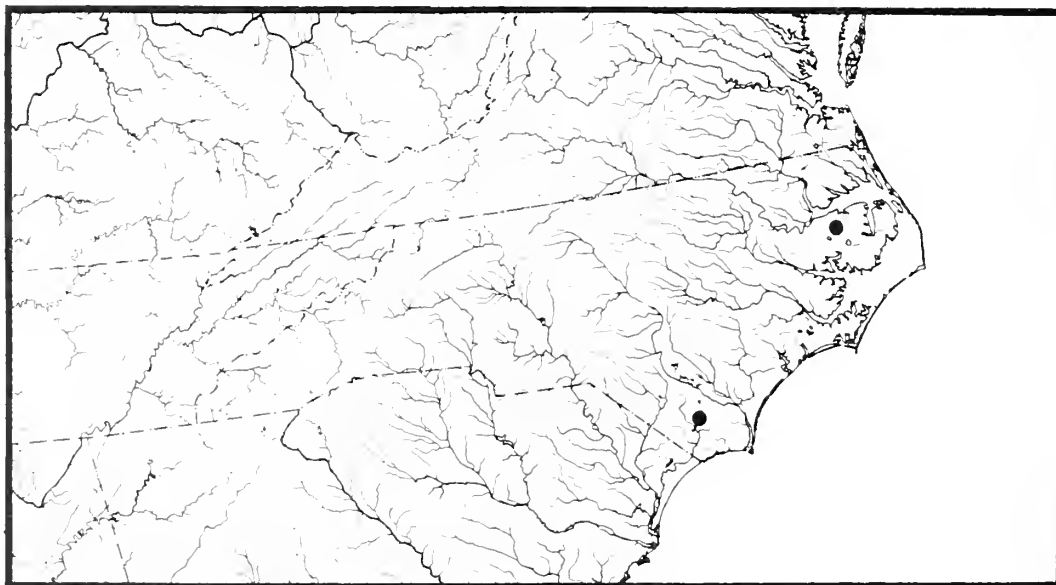
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: North shore of Lake Waccamaw, Columbus Co., NC (Hubbs and Raney 1946. Misc. Publ. Mus. Zool. Univ. Mich. 65:1-30).

SYSTEMATICS: Subgenus *Fontinus*. Lacustrine derivative of *F. diaphanus* (Hubbs and Raney 1946).



NC: Columbus Co., Lake Waccamaw, male, 55 mm SL (UNC-W).



DISTRIBUTION AND HABITAT: Originally thought to be endemic to Lake Waccamaw, but recently taken in Phelps Lake, NC (Bailey in Cooper et al. [eds.] 1977, *Endangered and Threatened Plants and Animals of North Carolina*:265-98). Phelps Lake population may or may not be introduced. Any additional information based on comparison of specimens should show some degree of differentiation if natural. Mid-water species occurring in large schools over sandy bottom in open waters or near emergent vegetation on shoals or around shores. In winter commonly found in swamps and canals surrounding Lake Waccamaw (Lindquist et al. in press, J.Elisha Mitchell Sci. Soc.).

ADULT SIZE: 45-85 mm SL.

BIOLOGY: Although mouth is superior, species feeds primarily on benthos (chironomid larvae and amphipods). Spawns early March to August. Males defend territories with lateral displays, and spawn with passing females on silty substrate. Approximately 100 eggs, 2 mm diameter, laid at one spawning (Shute et al. 1979, ASB Bull. 26: 49).

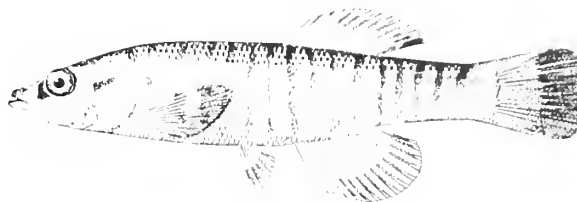
Compiler: P. W. Shute, October 1978.

Fundulus zebrinus Jordan and Gilbert
Plains killifish

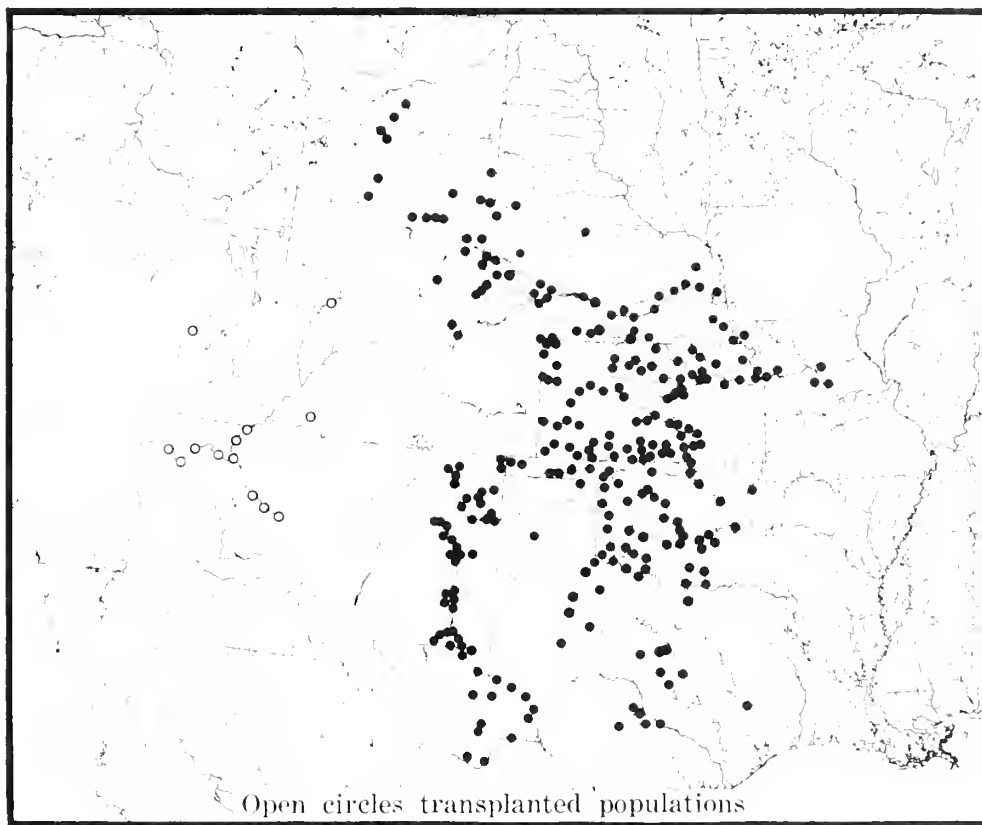
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: "Rio Grande in New Mexico" (Jordan and Gilbert 1883. Bull. U.S. Natl. Mus. 16:1-1018).

SYSTEMATICS: Subgenus *Plancterus*. Name *zebrinus* is substitute name for *zebra* preoccupied in *Fundulus*. Hybridization in nature with *F. sciadicus* documented by Hubbs et al. (1943. Contrib. Lab. Vert. Bio., Univ. Mich. 23:1-21). *Fundulus kansae*, once considered full species, now regarded as subspecies of *F. zebrinus* (Drewry 1967. Ph.D. diss., Univ. Texas).



KS: Ellis (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: South-eastern MT east to MO and south to TX. Apparently introduced in UT, western AZ, and upper Rio Grande drainage proper (although native to Pecos). Normally inhabits shallow (rarely deeper than 15 cm), sandy-bottomed streams. Many localities highly alkaline or saline. *Fundulus z. zebrinus* in Trinity, Brazos, and Colorado river drainages of TX, and Rio Grande/Pecos drainage of TX and NM; *F. z. kansae* elsewhere (Miller 1955. Occas. Pap. Mus. Zool. Univ. Mich. 568:1-25; Van Conner 1977. Ph.D. diss., Tulane Univ.).

ADULT SIZE: 38 mm - 100 mm TL.

BIOLOGY: Omnivorous, with insects and other aquatic invertebrates making up bulk of diet. Diatoms and other plant materials

ingested when invertebrates scarce (Bonham 1962. M.A. thesis, Univ. Missouri). Spawns in summer in small pools over sand and gravel bottom (Miller and Robison 1973. *The Fishes of Oklahoma*; Carlander 1969. *Handbook of Freshwater Fishery Biology* Vol. 1). Males, though not territorial, become aggressive while spawning (Koster 1948. Copeia: 25-33). Diurnal periodicity discussed by Echelle et al. (1971. Proc. Okla. Acad. Sci. 51:1-2). Griffith (1974. Copeia: 319-31) studied salinity tolerance. Burying behavior described by Minckley and Klaasen (1969. Copeia: 200-01). Ecology and erythrocyte morphology reported by Srivastava and Griffith (1974. Copeia: 136-41).

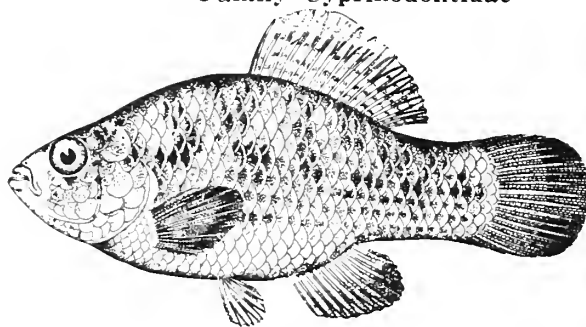
Compilers: J. R. Shute and A. W. Allen.
May 1979.

Jordanella floridae Goode and Bean
Flagfish

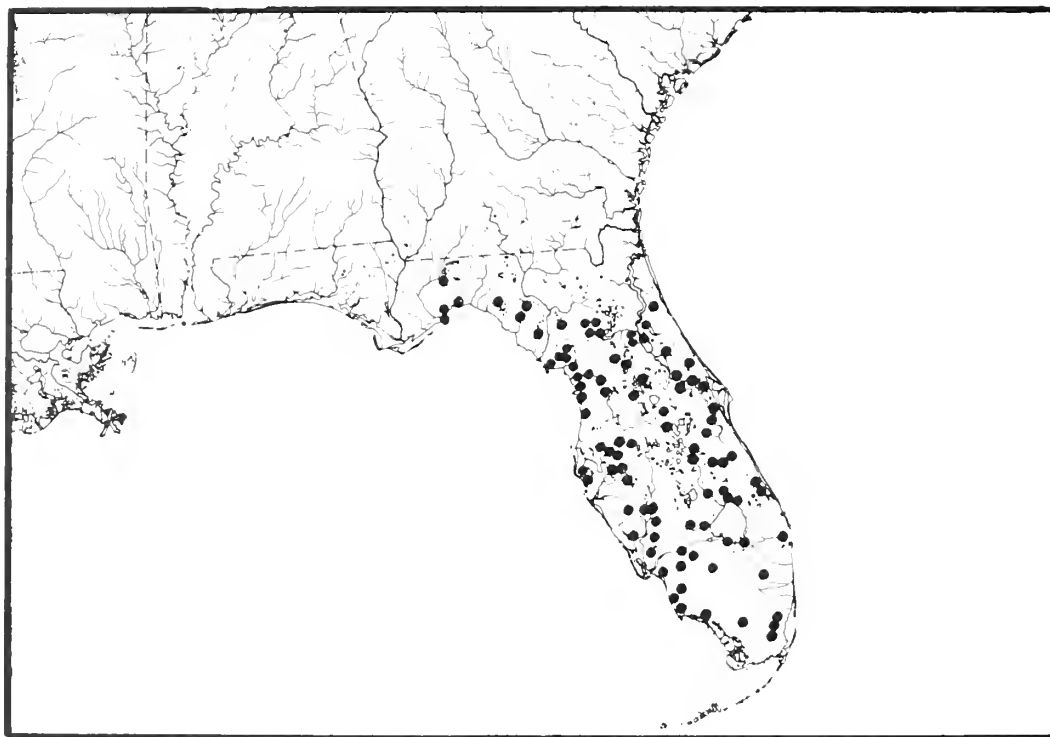
TYPE LOCALITY: Lake Monroe (St. Johns River), FL (Goode and Bean in Goode 1879. Proc. U.S. Natl. Mus. [1879] 2: 108-21).

SYSTEMATICS: No study published. Most closely related to *Garmanella pulchra* of Yucatan (Hubbs 1936. Carnegie Inst. Washington Publ. 457: 157-287); also closely related to *Floridichthys* and *Cyprinodon* (Hubbs 1926. Misc. Publ. Mus. Zool. Univ. Mich. 16: 1-86).

Order Atheriniformes
Family Cyprinodontidae



FL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Endemic to peninsular FL, where ranges from southern tip of state north to St. Johns River drainage in Alachua Co., (Newnan's Lake), and west along Gulf coast to extreme lower Ochlockonee River drainage in Wakulla and Franklin counties (Swift et al. 1977. Bull. Tall Timbers Res. Sta. 20: 1-111). Most northerly FL record from vicinity of Tallahassee, based on single specimen thought to be introduction (Swift et al. 1977). Unconfirmed records from Charleston Co., SC, which, if valid, obviously based on introductions. Typically in shallow, open, heavily vegetated ditches, ponds and lakes, often of ephemeral nature. Often common, particularly in more southern parts of range.

ADULT SIZE: up to 39 mm SL.

BIOLOGY: Kaill (1967. Ph.D. diss., Cornell Univ.) studied ecology and behavior, and Foster (1967. Stud. Trop. Oceanogr. 5: 549-66) described aspects of behavior. Kilby (1955. Tulane Stud. Zool. 2: 175-247) found species to occur commonly in brackish water at salinities up to 26.1 ppt. Foster (1967) described as "bottom-feeding herbivore." Appearance of numerous young of uniform size in isolated, previously dry ponds suggests eggs can survive severely reduced moisture, as is true of various other killifishes.

Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Leptolucania ommata (Jordan)
Pygmy killifish

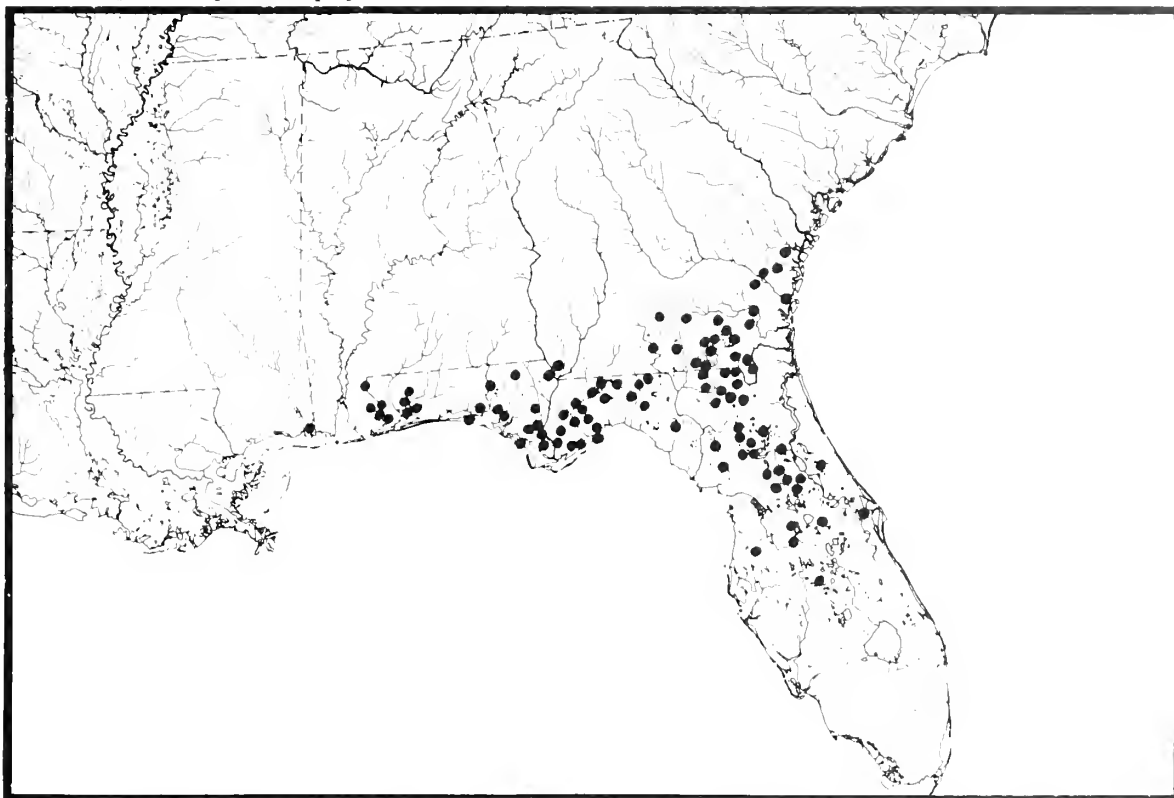
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Indian River, near Titusville, Brevard Co., FL. Exact site of collection may not be in Indian River proper, but a small tributary nearby. (Jordan 1884. Proc. U.S. Natl. Mus. 7:322-24).

SYSTEMATICS: No definitive study published, but Arndt (1971. Ph.D. diss., Cornell Univ.) provided detailed species description. Although referred to genus *Lucania* by some authors (Jordan and Evermann 1896. U.S. Natl. Mus. Bull. 47:1-1240), Hubbs and Miller (1965. Misc. Publ. Mus. Zool. Univ. Mich. 127:1-104) considered *Leptolucania* to belong to separate phyletic line.



GA: Seminole Co., Lewis Pond,
19 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Central peninsular FL north to Ogeechee River drainage, GA (Dahlberg and Scott 1971. Bull. Ga. Acad. Sci. 29:1-64), and west at least to Perdido River drainage, FL and AL. Smith-Vaniz (1968. *Freshwater Fishes of Alabama*) reported it from Escatawpa River drainage, southeast MS, based on single specimen, but Beckham (1977. Southeastern Fishes Council. Proc. 2:1-4) did not list from there. Record from Hillsborough River drainage, north of Tampa, FL, also based on single individual (Barnett 1972. M.S. thesis, Univ. South Florida). Occurs in shallow, heavily vegetated sloughs and streams with little or no current, in water that is soft and darkly stained from tannins and other organic acids. Often common to abundant.

ADULT SIZE: 15-24 mm SL.

BIOLOGY: Arndt (1971) studied ecology and reproductive behavior, and described color and secondary sexual characters. Breeds at least from early April to late August, with some adults possibly reproducing throughout year. Spawns in heavy submergent vegetation. Feeds by sight, principally on small arthropods and other invertebrates picked off vegetation. Maximum age probably no more than two years.

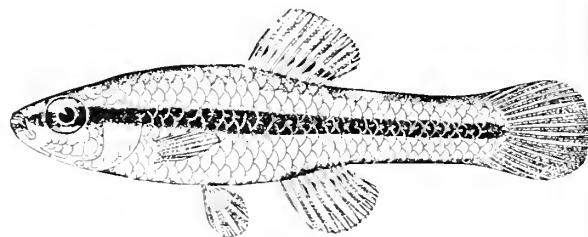
Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Lucania goodei Jordan
Bluefin killifish

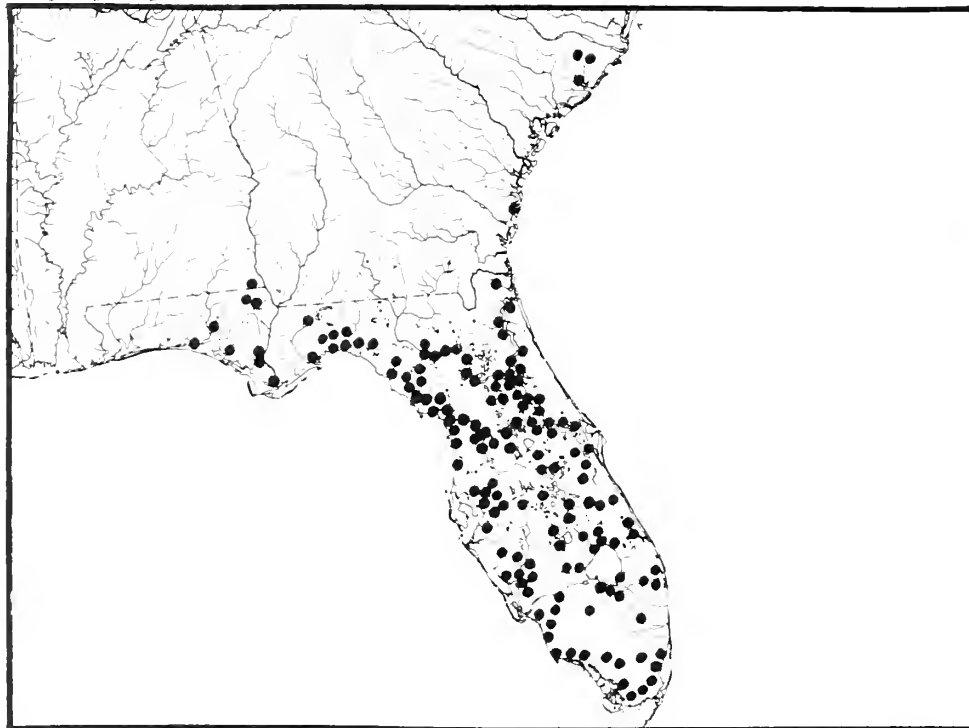
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: Arlington River (tributary to St. Johns River), at Jacksonville, Duval Co., FL (Jordan 1880. Proc. U.S. Natl. Mus. [1879] 2: 235-241).

SYSTEMATICS: Arndt (1971. Ph.D. diss., Cornell Univ.) provided detailed species description. Formerly referred to monotypic genus *Chriopeops*, but replaced in *Lucania* by Briggs (1958. Bull. Fla. State Mus. Biol. Sci. 2: 223-318). Hubbs and Miller (1965. Misc. Publ. Mus. Zool. Univ. Mich. 127: 1-111) listed distinguishing characters of *Chriopeops* and *Lucania*, and suggested subgeneric status for former. They also indicated that closest relatives of *Lucania* probably are *Cubanichthys cubensis* of Cuba and *Chriopeoides pengelleyi* of Jamaica.



FL: ca. 33 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Mostly confined to peninsular FL. West in FL to lower Choctawhatchee River drainage, north in coastal GA to Ogeechee River drainage (not mapped) (Dahlberg and Scott 1971. Bull. Ga. Acad. Sci. 29: 1-64). Also recorded from central SC coast, where presumably introduced (Loyacano 1975. Bull. South Carolina Exp. Stat. 580: 1-8). One record from extreme southeastern AL (Smith-Vaniz 1968. *Freshwater Fishes of Alabama*). In heavily vegetated ponds and streams, in areas of little or no current. Frequently associated with spring habitats, and may occur in waters of moderate salinities (up to 10.3 ppt) (Kilby 1955. Tulane Stud. Zool. 2: 175-247). Usually common to abundant.
ADULT SIZE: 16-42 mm SL.

BIOLOGY: Arndt (1971) studied ecology and reproductive behavior. Breeding occurs from late January to mid-September throughout most of range, with reproductive peak from late March to mid-summer (some populations appear to reproduce throughout year). Eggs laid in dense vegetation. Maximum age not definitely determined, but probably no more than two years. Food mostly epiphytes and sometimes bits of vascular plants. Species may occur in waters of extremely low dissolved oxygen content, where it apparently uses small, upturned mouth to obtain oxygen from thin surface film as does *Gambusia affinis* (Lewis 1970. Copeia: 319-26).

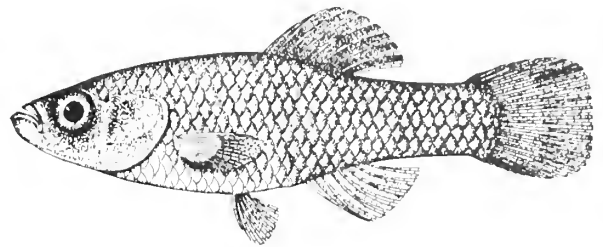
Compilers: C. R. Gilbert and G. H. Burgess. May 1979.

***Lucania parva* (Baird)**
Rainwater killifish

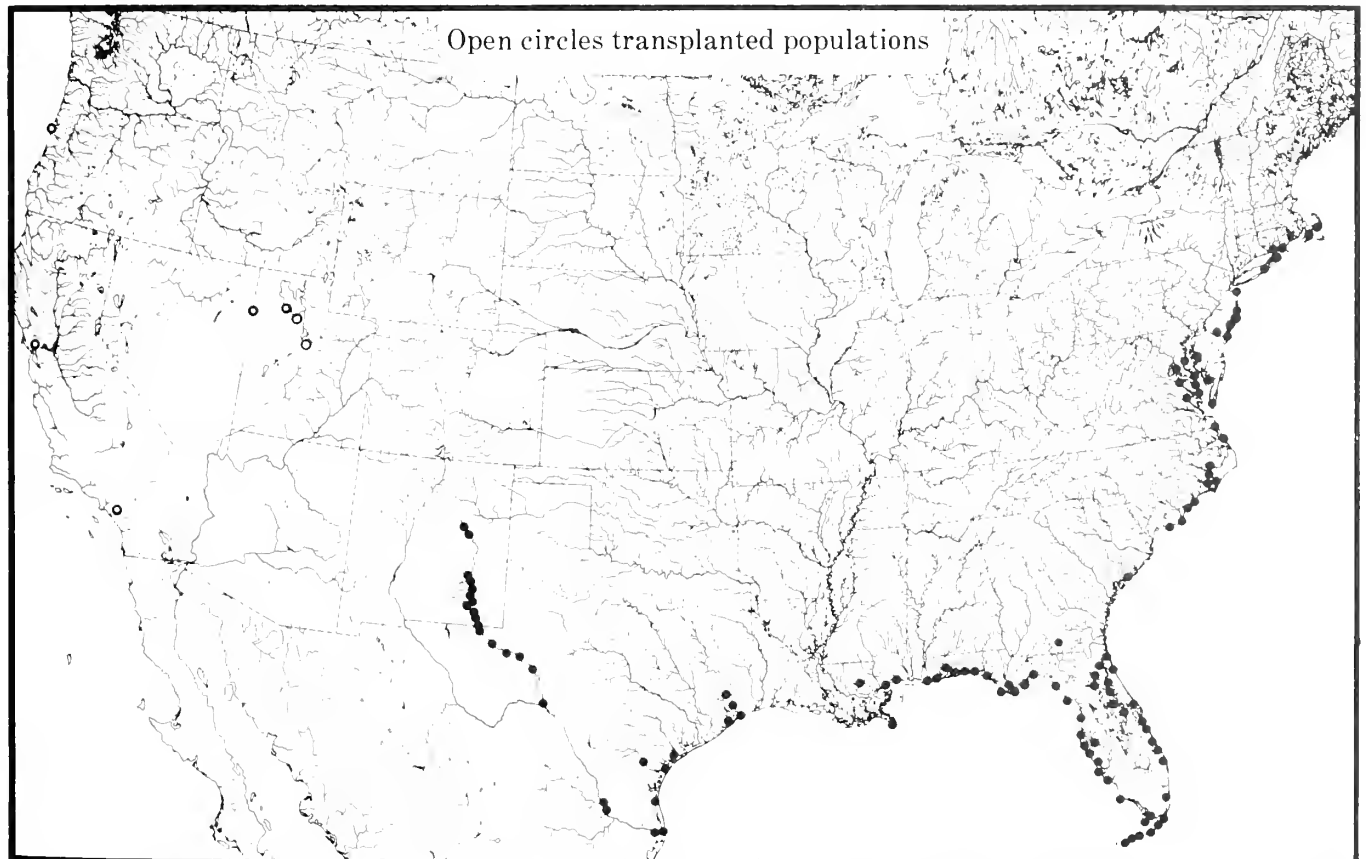
Order Atheriniformes
Family Cypinodontidae

TYPE LOCALITY: Greenport, Long Island, NY (Baird 1855. Ninth Annu. Rept. Smithsonian. Inst. [1854] :317-52).

SYSTEMATICS: Systematics and variation reviewed by Hubbs and Miller (1965. Misc. Publ. Mus. Zool. Univ. Mich. 127:1-104). Shows considerable morphological variation (usually clinal) throughout range, but division into subspecies probably not justified. Gaps in distribution result from absence of aquatic vegetation in extreme southeastern FL (Lake Worth to Miami) (Relyea 1975. Sci. Biol. J. 1:49-52) and along GA coast (Dahlberg 1975. *Guide to the Coastal Fishes of Georgia and Nearby States*). Consequent interruption of gene flow contributes to variation. Probably closely related to *Cubanichthys cubensis* (Rosen 1975. Syst. Zool. 24:431-64) and *Chriopeoides pengelleyi*



NJ: (Jordan and Evermann 1900).



(Hubbs and Miller 1965). Hubbs et al. (1943. Contrib. Lab. Vertebr. Biol. Univ. Mich. 23: 1-21) described hybridization with *L. goodei*. Hubbs and Miller (1965) and Duggins (1975. M.S. thesis, Florida Atlantic Univ.) described morphological variation.

DISTRIBUTION AND HABITAT: Salt marshes, bays, and lagoons from Cape Cod, MA, to Tampico, Mexico. Common in fresh waters of St. Johns River system, FL (Burgess et al. 1977. Fla. Sci. 40:33-41) and Rio Grande and Pecos River in TX and NM. Recently collected in northeast Yucatan

Peninsula. Tolerates wide range of salinity (1 to 43 ppt). Invariably taken in presence of aquatic vegetation. Usually abundant in preferred habitat. Introduced into CA, NV, OR, and UT (Hubbs and Miller 1965).

ADULT SIZE: 15-58 mm SL.

BIOLOGY: Ecology, breeding habitats, ethology, oölogy, and development reported by Foster (1967. Ph.D. diss., Cornell Univ.). Hildebrand and Schroeder (1928. Bull. U.S. Bur. Fish. 43:1-366) also discussed biology.

Compiler: C. F. Duggins, Jr. October 1978.

Rivulus marmoratus Poey
Rivulus

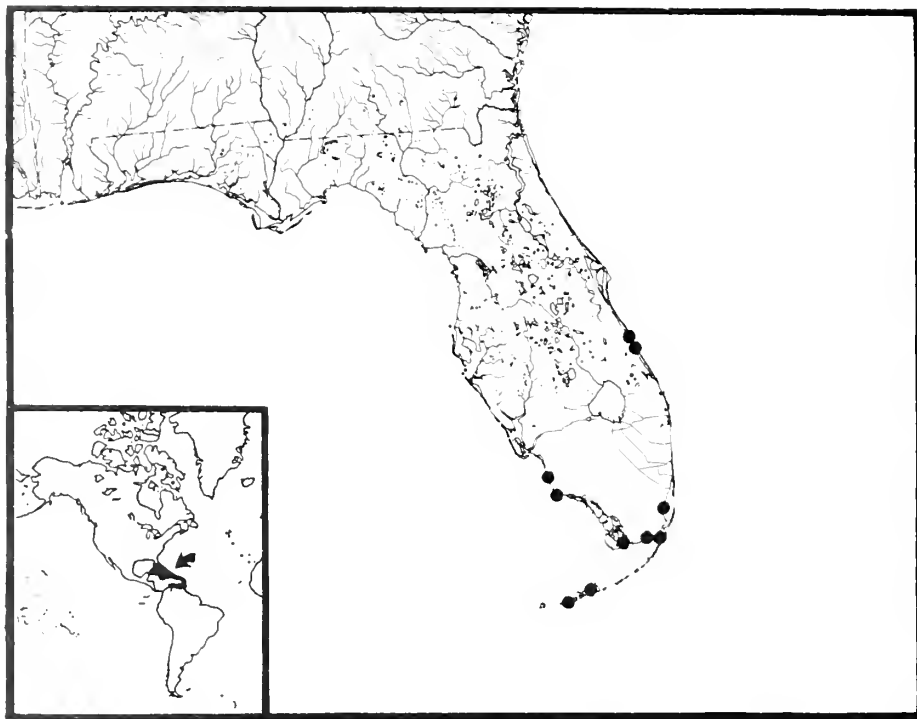
Order Atheriniformes
Family Cyprinodontidae

TYPE LOCALITY: "Cuba" (Poey 1880. Anal. Soc. Espanola Hist. Nat. 9:243-61).

SYSTEMATICS: No definitive study of species, but Myers (1927. Ann. Mag. Nat. Hist. 19: 115-29) reviewed genus. Harrington and Rivas (1958. Copeia: 125-30) redescribed species, based on FL specimens. Although not directly dealing with systematics, many of Harrington's papers (see below) have important systematic implications.



Bahamas: New Providence
Island, Lake Killarney,
33 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Widely distributed throughout West Indies, from Bahamas south to islands off Venezuela, including both Greater and Lesser Antilles. Continental distribution apparently limited to southern half of peninsular FL. In FL, occurs in ditches and along shores of bays, associated with estuarine mangroves, salt marshes, and other brackish-water situations. In very shallow water at salinities ranging from 0-32 ppt. Bottom material consists of marly muck, often associated with detritus, with little or no aquatic vegetation. Sometimes found in burrows of crabs (Harrington and Rivas 1958; Thomerson 1966. J. Am. Killifish Assoc. 3:48-51). Considered rare, but this may reflect secretive nature. Vulnerable, inhabiting areas particularly subject to human modification.

ADULT SIZE: 18-28 mm SL, 39.7 mm SL maximum.

BIOLOGY: Snelson (*in* Gilbert 1979. *Rare and Endangered Biota of Florida* 4:1-58) provided good general summary of biology and overall status in FL, where it is considered threatened. Limited food studies show it to be carnivorous, feeding on small crabs, snails, and larval and adult mosquitoes. Of limited importance as forage fish or in biological control, but of enormous scientific importance as only vertebrate known to be synchronous self-fertilizing hermaphrodite (fertilizes own eggs before laying). This seems to be true only of more northern populations, including all in FL, and represents a most extreme type of inbreeding. Harrington published extensive series of papers on this subject between 1961 and 1976.

Compilers: C. R. Gilbert and G. H. Burgess.
August 1979.

Belonesox belizanus Kner
Pike killifish

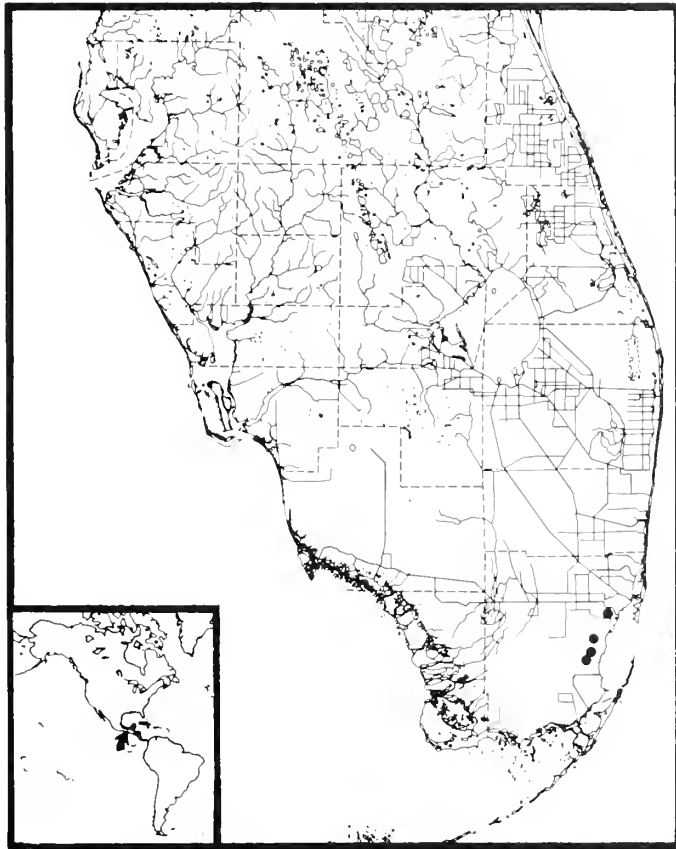
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Belize, Belize (Kner 1860. Sitzber. K. Akad. Wiss. Wien 40: 419-22).

SYSTEMATICS: In tribe Gambusiini. Genus monotypic. Two subspecies, *B. b. belizanus* and *B. b. macillosus*. Systematics treated by Hubbs (1936. Carnegie Inst. Wash. Publ. 457:157-287) and Rosen and Bailey (1963. Bull. Am. Mus. Nat. Hist. 126:1-176). Included in keys to freshwater fishes of United States by Moore (in Blair et al. 1968. *Vertebrates of the United States*) and FL by Stevenson (1976. *Vertebrates of Florida*).



FL: Dade Co., male (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Rio Antigua system, Veracruz, Mexico, south to Yucatan, Guatemala, Belize, and Atlantic drainages of Honduras, Nicaragua, and Costa Rica. Established in canals of southeastern Dade Co., FL. A previously established population in the San Antonio River, San Antonio, TX, apparently is no longer extant. Abundant at FL localities. Able to live in waters of low oxygen concentrations. Will tolerate sea water. Has lower temperature tolerance of 10-13°C. Introductions into United States due to releases of research and home aquarium fish.

ADULT SIZE: In FL, females 65-143 mm SL, 200 mm SL maximum, males 50-107 mm SL.

BIOLOGY: In FL, seriously impairs natural control of mosquito larvae by preying on *Gambusia affinis* and other native poeciliid and cyprinodontid fishes. In trophic competition with *Micropterus salmoides* and *Lepomis gulosus*. Shows female growth superiority and little sexual dichromatism. Small juveniles mimic floating vegetation through behavior and coloration. Information on brood sizes presented by Breder and Rosen (1966. *Modes of Reproduction in Fishes*).

Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Gambusia affinis (Baird and Girard)
Mosquitofish

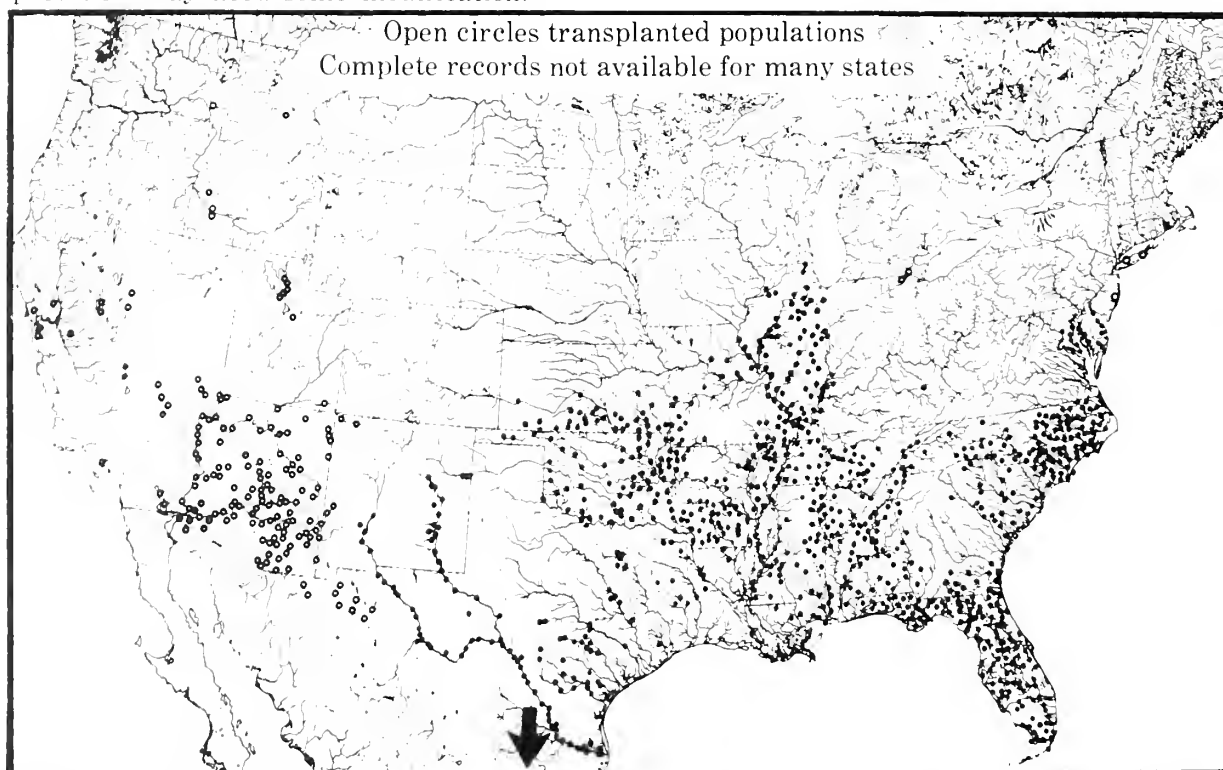
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Rio Medina and Rio Salado (San Antonio River drainages), TX (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. [1852-53] 6:387-90).

SYSTEMATICS: Hubbs (in Blair [ed.] 1961. *Vertebrate Speciation: A Symposium*: 5-23) recognized two morphologically distinctive subspecies, *G. a. holbrooki* (Atlantic slope and peninsular FL) and *G. a. affinis* (through Mississippi Valley to Rio Grande), noted intergradation in intervening coastal area, and suggested the two subspecies may warrant specific status. Black and Howell (1978. ASB Bull. 25:57), however, described three chromosomal forms from within natural range, suggesting former interpretation may need some modification.



MD: Caroline Co., Linchester Millpond, female, 30 mm TL, male, ca. 26 mm TL(NCSM).



DISTRIBUTION AND HABITAT: Southern IN and IL south to Veracruz, Mexico, and FL, north along Atlantic slope to southern NJ. Widely transplanted throughout United States and introduced extensively into warm areas of world for mosquito control. Stocking this aggressive fish in American southwest has extirpated many rare, localized populations of native species. Common to abundant in vegetated ponds, lakes, drainage ditches, and backwaters and oxbows of sluggish streams, where tends to swim near surface. Less common in moderate gradient streams. Often found in brackish or marine situations.

ADULT SIZE: 19-36 mm TL (males), 31-59 mm TL (females).

BIOLOGY: Live-bearer that spawns during warm months. Gestation period 21-28 days; one female may produce 3-4 broods in a season (Krumholz 1948. Ecol. Monogr. 18:1-43). Females contain 1-315 embryos (Moyle 1976. *Inland Fishes of California*). Omnivorous; prefers mosquito larvae and pupae but consumes other invertebrates, zooplankton, fishes and algae (Harrington and Harrington 1961. Ecology 42:646-66). Carlander (1969. *Handbook of Freshwater Fishery Biology*, Vol. 1), Pflieger (1975. *Fishes of Missouri*), and Moyle (1976) presented biological reviews.

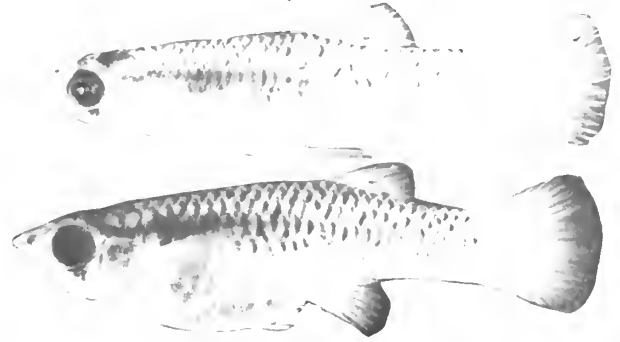
Compiler: D. S. Lee and G. H. Burgess.
December 1978.

Gambusia amistadensis Peden
Goodenough gambusia

Order Atheriniformes
Family Poeciliidae

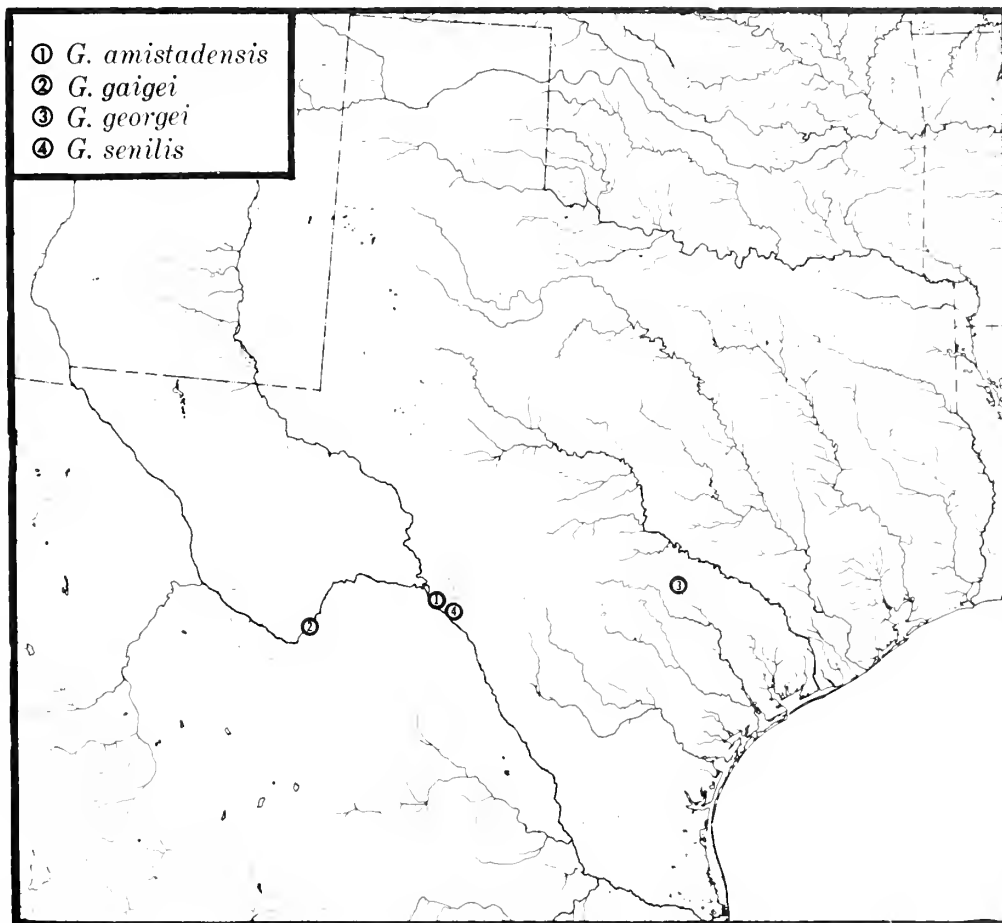
TYPE LOCALITY: Goodenough Springs near the Rio Grande, Val Verde Co., TX (Peden 1973a. Copeia: 210-21).

SYSTEMATICS: Member of *G. nobilis* species group. Closest relatives include *G. gaigei*, *G. hurtadoi*, and *G. alvarezii*. Variation and relationships discussed by Peden (1973a). Anal spot description and comparisons described by Peden (1973b. Copeia:250-63).



Upper, male (holotype) 24 mm SL.

Lower, female (paratype) 31.5 mm SL (Peden 1973a).



DISTRIBUTION AND HABITAT: Formerly endemic to Goodenough Spring and adjacent spring run, which flowed 1.3 km to Rio Grande. Site was inundated by Amistad Reservoir, extirpating species in its natural range. Stocks established in aquaria at University of Texas at Austin and ponds at Dexter National Fish Laboratory. Prior to inundation *G. amistadensis* was common in the large, rapid flowing, warm springs.

ADULT SIZE: 20-35 mm SL.

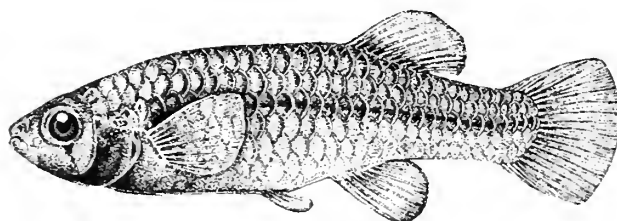
BIOLOGY: Reproductive behavior presented by Peden (1973b). General ecology and life history discussed by Peden (1973a).

Compiler: V. Guillory. November 1978.

Gambusia gaigei Hubbs
Big Bend gambusia

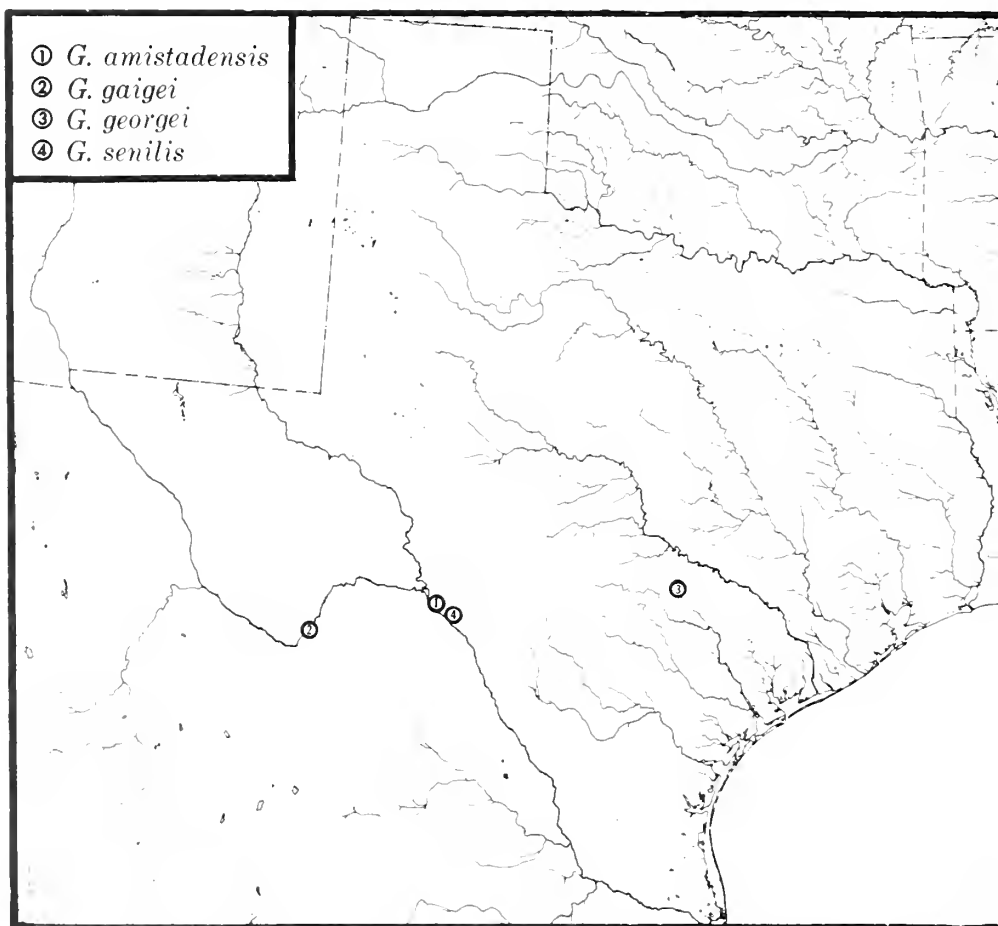
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: A marshy cattail slough fed by springs, located close to the Rio Grande at Boquillas Spring, Brewster Co., TX (Hubbs 1929, Occas. Pap. Mus. Zool. Univ. Mich. 198:1-11).



NM: Dexter National Fish hatchery, ca. 40 mm SL (NCSM).

SYSTEMATICS: Member of subgenus *Gambusia* and *G. nobilis* species group (Rivas 1963, Copeia:331-47). Description and morphological variation given in Hubbs (1929) and Hubbs and Springer (1957, Tex. J. Sci. 9:279-327). Anal spot variation described by Peden (1973, Copeia: 250-63).



DISTRIBUTION AND HABITAT: Endemic to Boquillas Spring and Graham Ranch Warm Springs (ca. 1.6 km southwest of Boquillas Spring), Brewster Co., TX (Hubbs and Springer 1957). Total population was reduced to only three individuals in 1957, with the population at the type locality extirpated. Later introduced into Croton Springs, on Graham Ranch, and Willow Tank (ca. 66 km west of type locality) (Hubbs and Brodrick 1963, Southwest. Nat. 8:46-48). Presently restricted to one artificial springfed pool in Big Bend National Park.

ADULT SIZE: 20-25 mm SL.

BIOLOGY: General ecology described by Hubbs and Springer (1957). Warburton (1958, M.A. thesis, Univ. Texas) studied response to environmental conditions, whereas Peden (1973) elaborated on reproductive behavior.

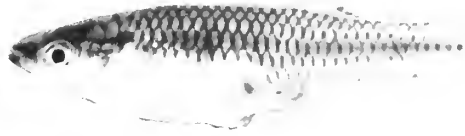
Compiler: V. Guillory, November 1978.

***Gambusia geiseri* Hubbs and Hubbs**
Largespring gambusia

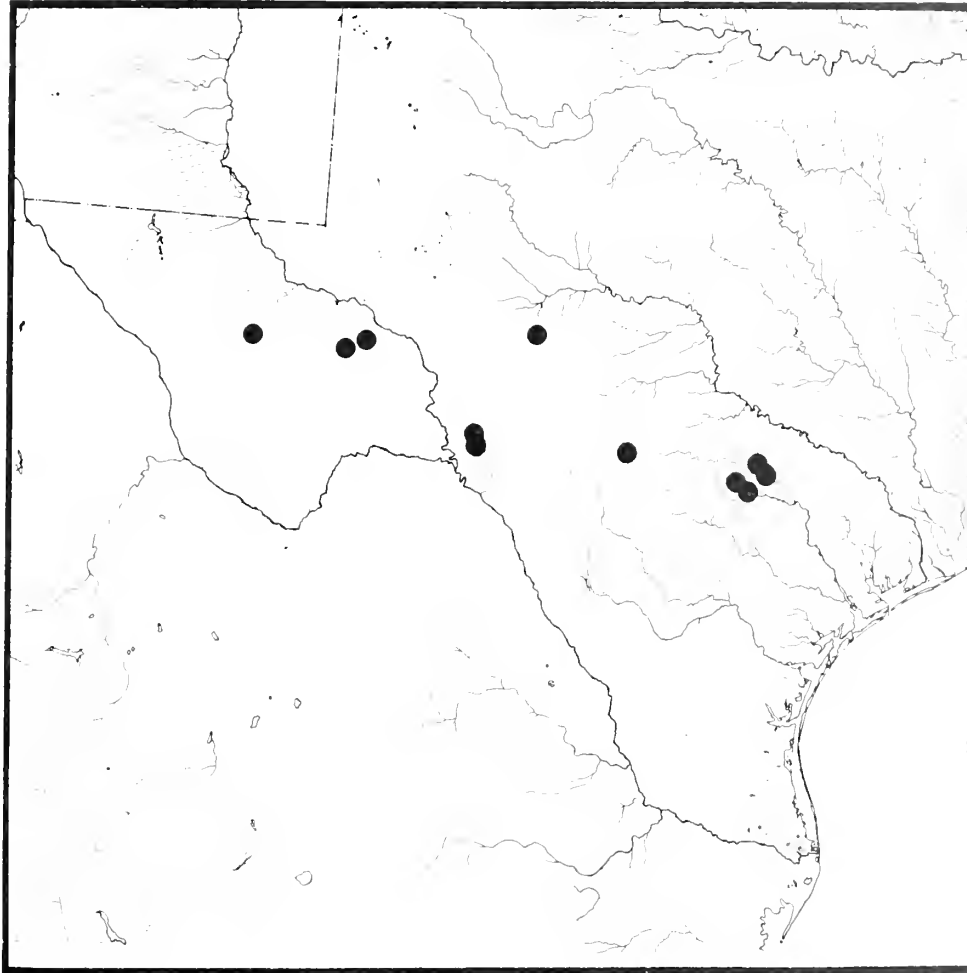
Order Antheriniformes
Family Poeciliidae

TYPE LOCALITY: San Marcos River just downstream from Rio Vista Dam, San Marcos, Hays Co., TX (Hubbs and Hubbs in Hubbs and Springer 1957. Tex. J. Sci. 9:279-327).

SYSTEMATICS: Member of *G. nobilis* species group (Hubbs and Springer 1957), which occurs in northeastern Mexico and southwestern United States. Only member of group with recurved hooks on proximal spines of ray three (male gonopodium).



TX: Val Verde Co., Devil's River (H. L. Harrell).



DISTRIBUTION AND HABITAT: Nine localities in TX: San Marcos Springs, and introduced in adjacent section of San Marcos River, Hays Co. (Conner 1977. Ph.D. diss., Tulane Univ.); Comal Springs and adjacent section of Comal Creek; Bear Creek, Comal Co.; headsprings of South Fork Guadalupe River, Kerr Co.; headsprings of Concho River, Schleicher Co.; headsprings of Devil's River, Val Verde Co.; ditch east of Toyahvale, Reeves Co.; and Comanche and Tunis springs, Pecos Co. Only in cold clear, high-volume discharge springs near emergence from underground limestone aquifers.

ADULT SIZE: 16-34 mm SL.

BIOLOGY: Since habitat is physically constant, species may breed year-round. Gravid females dominate populations from late March to early June (at least in Devil's River). Often far outnumbered *G. affinis* where the two occur together.

Compiler: H. L. Harrell. June 1978.

Gambusia georgei Hubbs and Peden
San Marcos gambusia

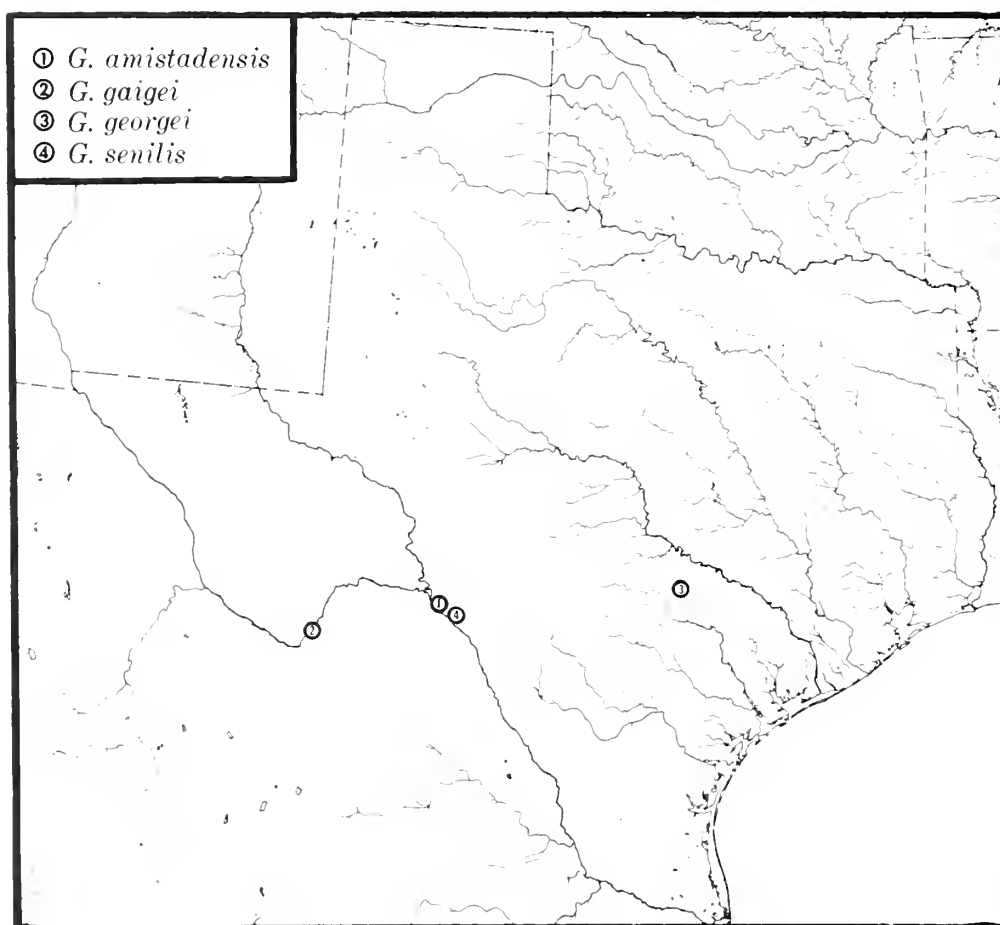
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: San Marcos River at hwy. I-35 bridge, Hays Co., TX (Hubbs and Peden 1969. Copeia:357-64).

SYSTEMATICS: Systematic relationships and description in Hubbs and Peden (1969). Most distinct *Gambusia* morphologically; not closely related to any other species. Anal spot variation discussed by Peden (1973. Copeia: 250-63).



TX: Hays Co., Guadalupe drainage, male, 30 mm SL.
female, 30 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to 2 km of San Marcos River between Rio Vista Dam and 0.5 km below I-35 bridge. Also recorded historically from San Marcos spring. Essentially restricted to shallow, quiet, mud-bottomed, shoreline areas without dense vegetation in thermally constant main channel. Formerly common under shaded bridges. Has declined in numbers and may be extinct. In 1969 population estimated at less than 1,000, whereas surveys in 1976 found none.

ADULT SIZE: 25-40 mm SL.

BIOLOGY: Little known about basic biology, although it appears to be the most ecologically distinct *Gambusia* (Hubbs and Peden 1973). Reproductive biology summarized by Peden (1970. Ph.D. diss., Univ. Texas).

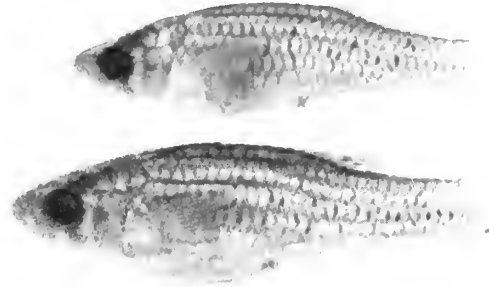
Compiler: V. Guillory, November 1978.

Gambusia heterochir Hubbs
Clear Creek gambusia

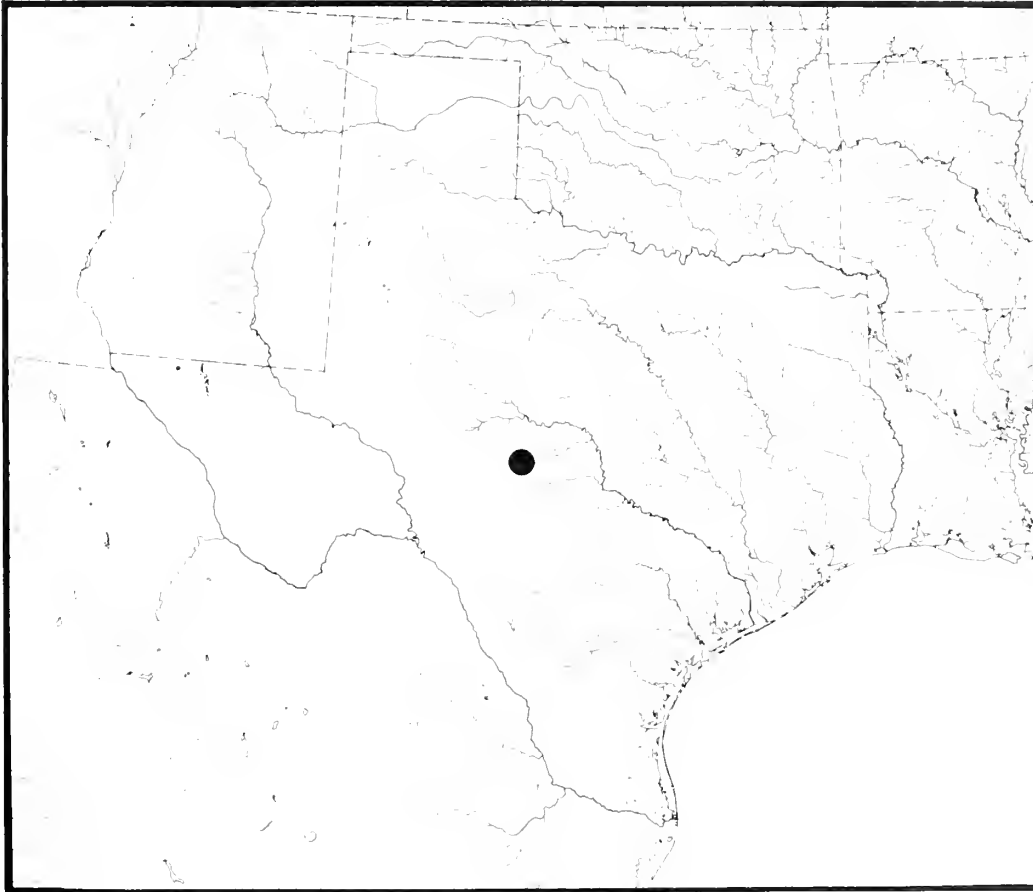
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Head spring of Clear Creek (16.8 km w of Menard), Menard Co., TX (Hubbs 1957. Tulane Stud. Zool. 5:3-16).

SYSTEMATICS: Believed to have evolved from ancestral stock of *G. nicaraguensis*. Hybridizes in nature with *G. affinis* (Hubbs 1957; 1959. Evolution 13:236-46).



TX: Menard Co., clear creek, male, 30 mm SL, female, 33 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Restricted to headwaters of Clear Creek, Menard Co., TX, which is now impounded. Populations apparently correlated with factors that were associated with *Ceratophyllum* beds. Hubbs (1957) found submerged and emergent vegetation prolific in all parts of Clear Creek.

ADULT SIZE: 25 mm SL (males), 45 mm SL (females).

BIOLOGY: Little known. Hubbs (1971. Bull. Tex. Mem. Mus. 19:1-46) discussed competition and isolating mechanisms in the *G. affinis* x *G. heterochir* hybrid swarm and Warburton et al. (1957. Copeia:299-300) reported on reproductive behavior.

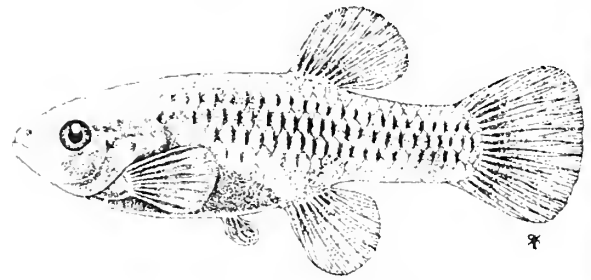
Compiler: F. C. Rohde. January 1978.

Gambusia nobilis Baird and Girard
Pecos gambusia

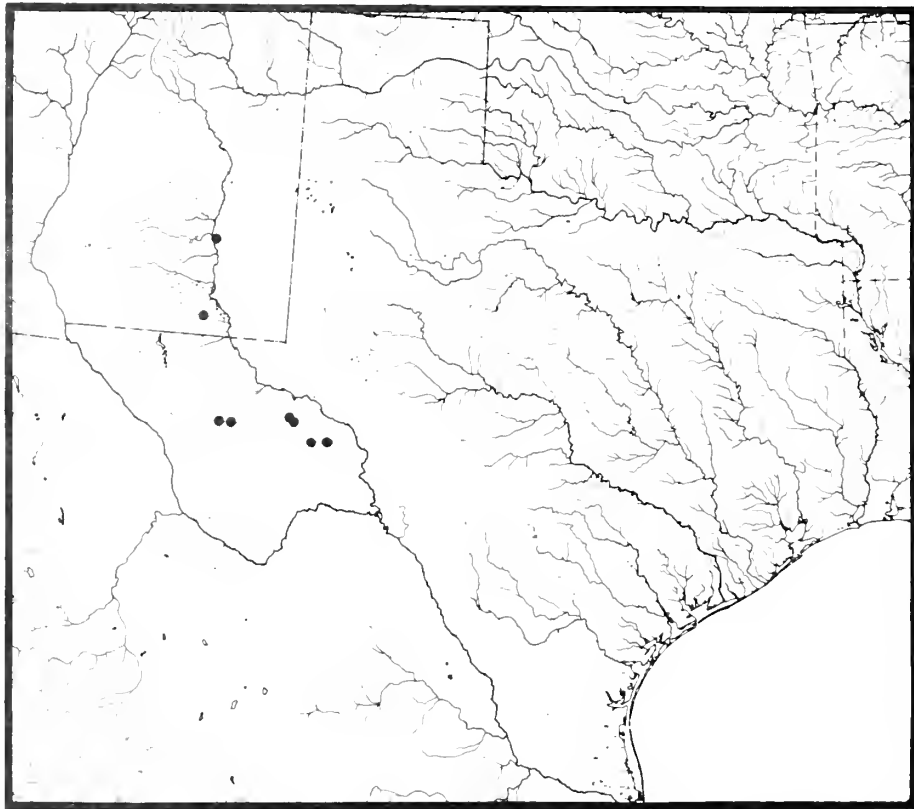
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Leona and Comanche springs, Rio Grande del Norte, TX (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. [1852-53] 6:387-90).

SYSTEMATICS: Closely related to *G. senilis*; both species placed in *G. nobilis* species group (Hubbs and Springer 1957. Tex. J. Sci. 9:279-327; Rivas 1963. Copeia: 331-47; Rosen and Bailey 1963. Bull. Am. Mus. Nat. Hist. 126:1-176). Peden (1973. Copeia: 250-63) described and discussed significance of anal spot.



NM: Eddy Co., Blue Spring,
ca. 30 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Western tributaries of Pecos River in TX and NM. Populations greatly depleted by *G. affinis* introductions and lowering of water table. Distribution in NM currently limited to Bitter Lake National Wildlife Refuge and Blue Springs, a Black River tributary. Typically inhabits shallow margins of clear vegetated spring waters high in calcium carbonate, although also found in more adverse sink-hole habitats.

ADULT SIZE: 25-40 mm SL.

BIOLOGY: Basic life history studied by Bednarz (1975. New Mexico Dept. Game Fish. Res. Rept.:1-30). Courtship behavior described by Peden (1973). General ecology discussed by Hubbs and Echelle (1972. Proc. Symp. Rare and End. Wildl. Southwest. U.S., New Mexico Dept. Game and Fish) and Hubbs and Springer (1957).

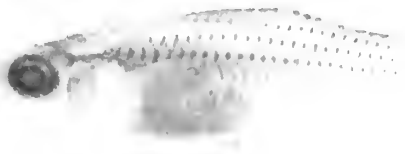
Compiler: V. Guillory. November 1978.

Gambusia rhizophorae Rivas
Mangrove gambusia

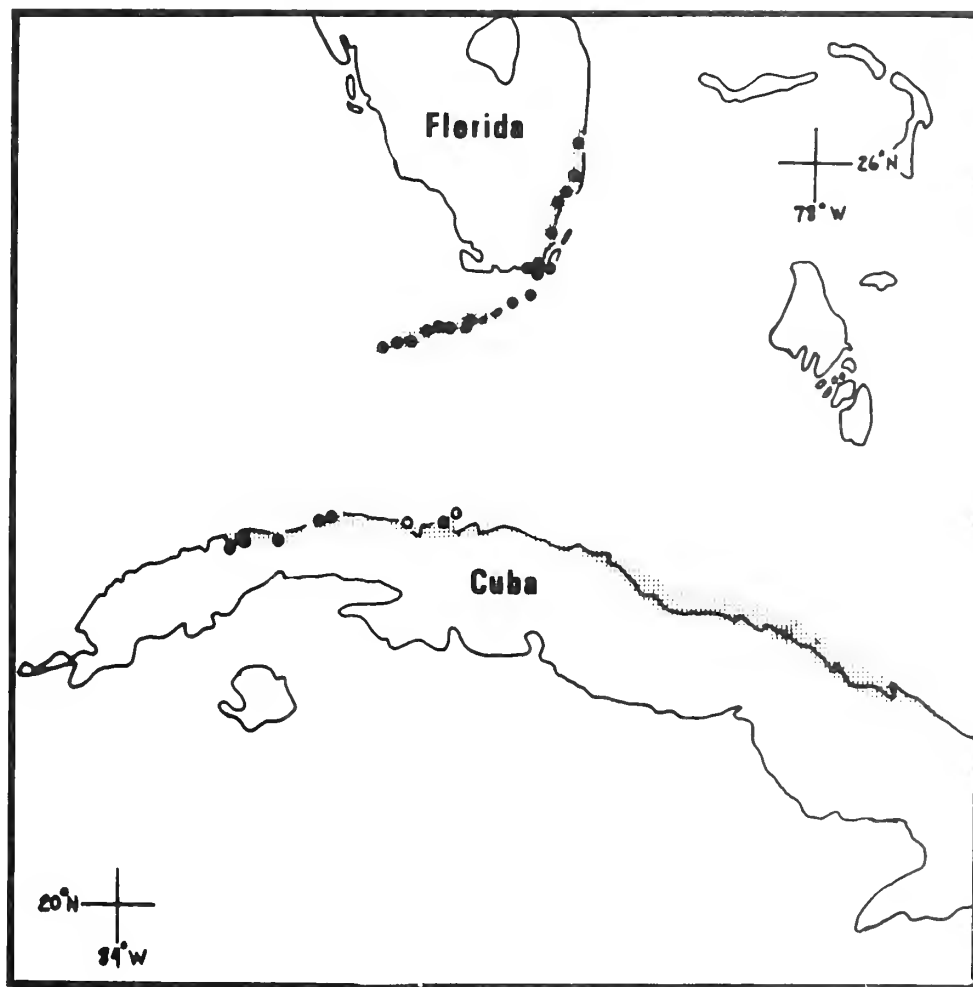
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Mangrove swamp at Matheson Hammock, Miami, Dade Co., FL (Rivas 1969, Copeia: 778-95).

SYSTEMATICS: Similar morphologically to, but distinct from, *G. punctata*. Member of *punctata* species group (Rosen and Bailey, 1963 Bull. Am. Mus. Nat. Hist. 126:1-176).



FL: Monroe Co., Bahia Honda Key, 33 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Brackish and salt water in extreme southeastern mainland FL and Florida Keys, euryhaline in Cuba (Getter 1976, M.S. thesis, Univ. Miami).

ADULT SIZE: Males 15-39 mm SL, females 15-51 mm SL.

BIOLOGY: Restricted in FL to red mangroves. Feeds on floating terrestrial insects. Reproductive peak in spring, brood size from 2-65 mm (average 13.4) and sexually inactive in winter. Lives one year or less and hybridizes naturally with *G. affinis holbrooki* (Getter 1976.)

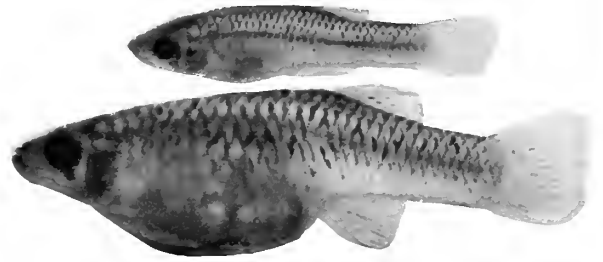
Compiler: C. D. Getter, September 1978.

***Gambusia senilis* Girard**
Blotched gambusia

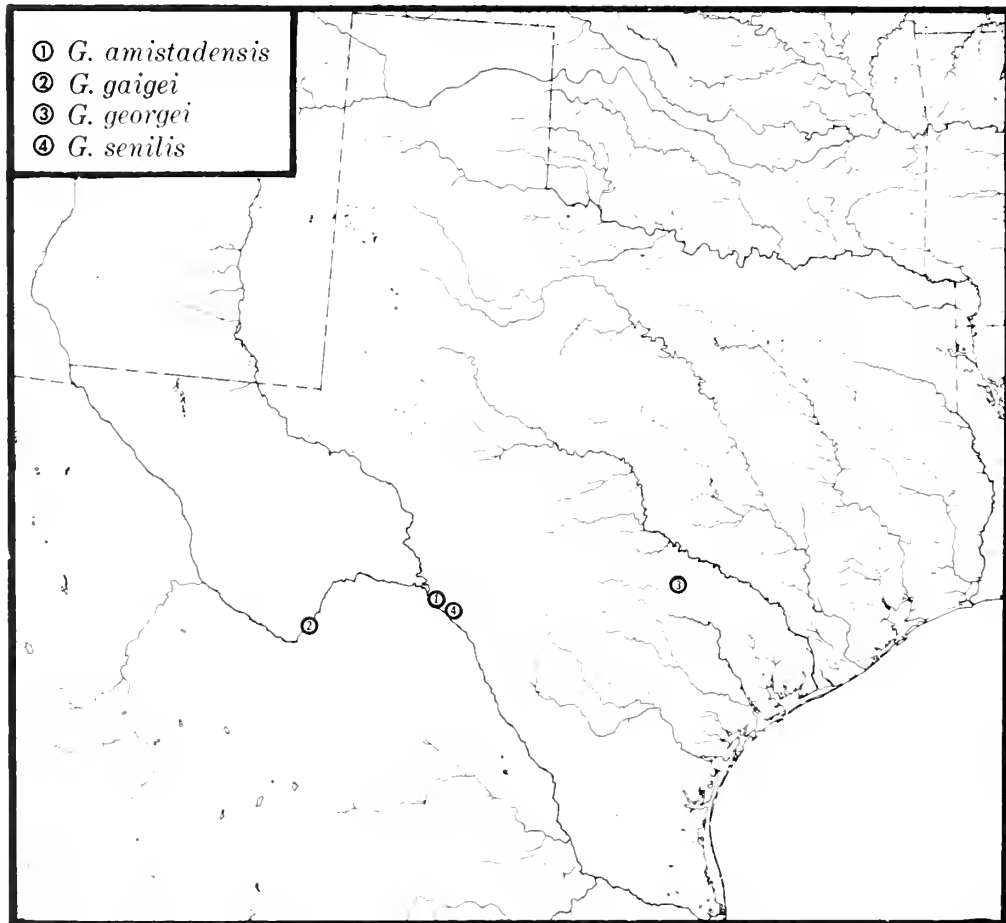
Order Atheriniformes
 Family Poeciliidae

TYPE LOCALITY: Rio Chihuahua [Rio Grande drainage], Mexico (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:113-22).

SYSTEMATICS: Member of *G. nobilis* species group, with closest affinities to allopatric *G. nobilis* (Hubbs and Springer 1957. Tex. J. Sci. 9:279-327; Rivas 1963. Copeia:331-47; Rosen and Bailey 1963. Bull. Am. Mus. Nat. Hist. 126:1-176). Anal spot variation described by Peden (1973. Copeia:250-63).



Mexico: Rio San Pedro, male, 21 mm SL, female, 34 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Devils River, TX (Hubbs 1958. Copeia:239) and Rio Conchos and tributaries, Chihuahua and Durango, Mexico (Hubbs and Springer 1957). Widely distributed in Rio Conchos but limited in Devils River. Usually collected in quiet, weed-choked surface waters, although tolerant of wide variations in temperature, chemical conditions, and water flow and clarity.

ADULT SIZE: 20-35 mm SL.

BIOLOGY: Little known. Peden (1973) discussed courtship behavior.

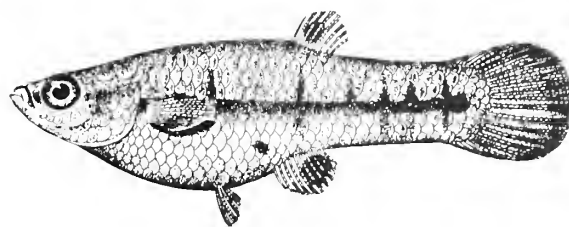
Compiler: V. Guillory. November 1978.

Heterandria formosa Agassiz
Least killifish

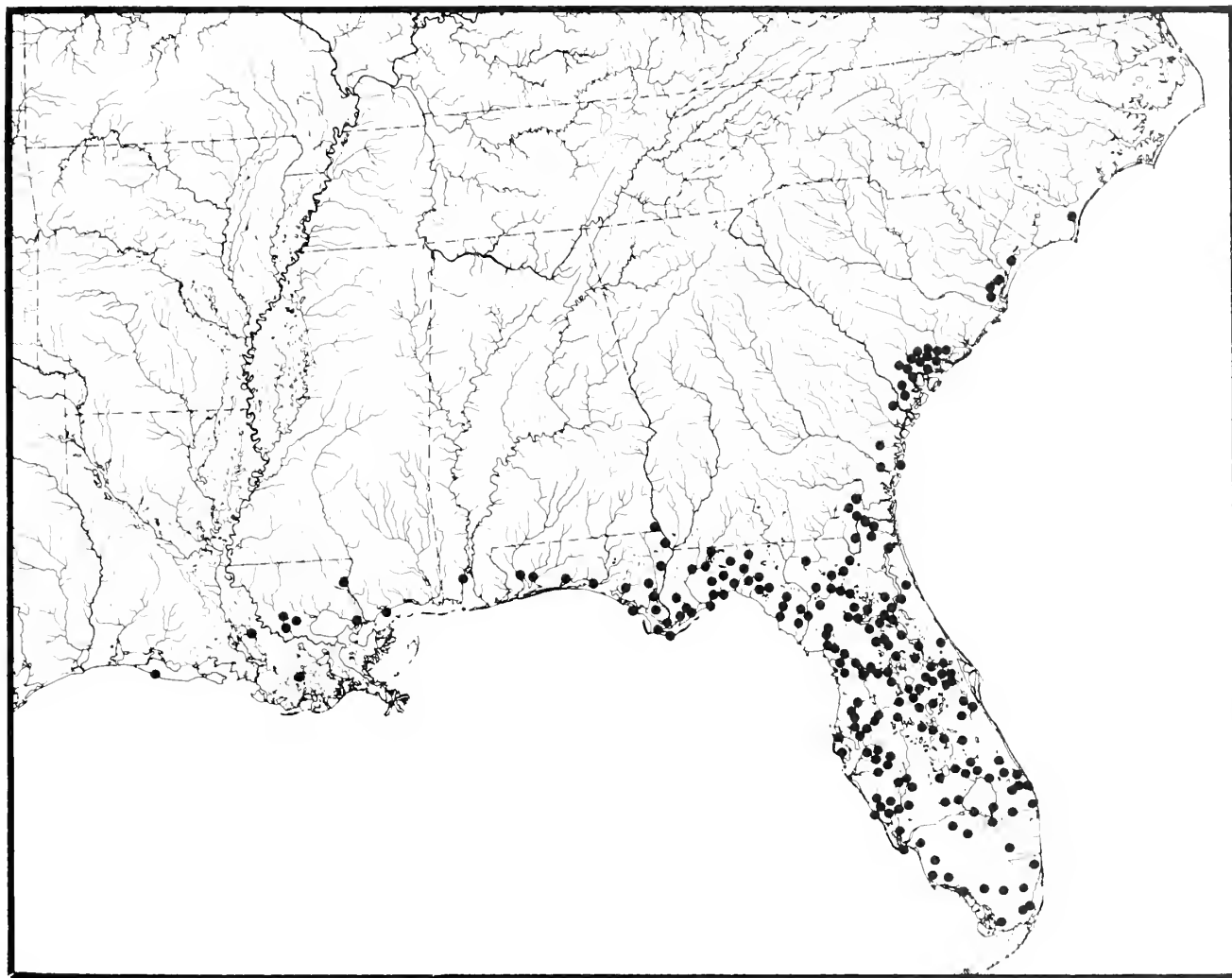
Order Cyprinodontiformes
Family Poeciliidae

TYPE LOCALITY: "Mobile, Alabama, New Orleans, Louisiana, and Gulf States" (Agassiz 1855. Am. J. Sci. Arts [Ser. 2] 19:134-36).

SYSTEMATICS: Tribe Heterandriini. Rosen and Bailey (1963. Bull. Am. Mus. Nat. Hist. 126:1-176) briefly reviewed species. Only other *Heterandria* is *H. bimaculatus*, a Middle American species.



(Jordan and Evermann 1900)



DISTRIBUTION AND HABITAT: Lower Cape Fear River drainage in extreme southeast NC, to lower Mississippi River drainage in southeast LA. Confined to coastal areas except in FL, where occurs throughout peninsular areas. In weedy pond and stream margins, from fresh to brackish (about 30 ppt) water.

BIOLOGY: Seal (1911. Proc. Biol. Soc. Wash. 24:91-96), Schultze (1924. Biatt. Aquar.-Terrarienk. 35:234-26), Turner (1937. Biol. Bull. Woods Hole 72:145-64), Fraser and Renton 1940. Quart. J. Micros. Sci. London 81:479-518), and Scrimshaw (1944. Copeia: 180-83) reported on reproduction. Feeding ecology analyzed by Reimer (1970. Am. Midl. Nat. 83:311-15).

ADULT SIZE: 12-30 mm SL.

Compiler F. D. Martin. September 1978.

Poecilia formosa (Girard)
Amazon molly

Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Paolo [sic] Alto, Mexico (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:113-22), possibly Palo Alto Battlefield in TX, e of Brownsville (Drewry et al. 1958. Tex. J. Sci. 10:489-90).

SYSTEMATICS: Subgenus *Poecilia*. Evidence indicates this species originally resulted from hybridization between *P. mexicana* and *P. latipinna* (Hubbs and Hubbs 1932. Science 76:628-30). Natural Amazon mollies indistinguishable from laboratory hybrids of these two species (Abramoff et al. 1968. Am. Nat. 102:555-58). All natural *P. formosa* are females (hence name "Amazon molly"), and eggs develop parthenogenetically.



Mexico: Veracruz, 34 mm SL (NCSM).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Possibly native to coastal portion of Nueces River and around Kingsville, TX; certainly native to lower Rio Grande Valley of TX and coastal streams and lagoons south in Mexico to mouth of Rio Tuxpan. Introduced populations in San Marcos River at San Marcos, TX, and San Antonio River at San Antonio, TX. Prefers sluggish streams and ditches with fresh or brackish water.

ADULT SIZE: 30-80 mm SL.

BIOLOGY: Environmental factors influencing male formation and reproductive ecology, including sexual parasitism on parental species, analyzed by Hubbs (1964. Bull. Tex. Mem. Mus. 8: 1-72). General ecology summarized by Darnell and Abramoff (1968. Copeia: 354-61) and Minckley and Koehn (1966. J. Ariz. Acad. Sci. 4:46-49).

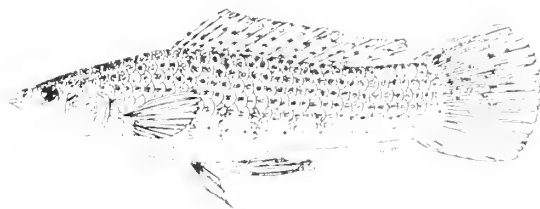
Compiler: F. D. Martin. September 1978.

Poecilia latipinna (Lesueur)
Sailfin molly

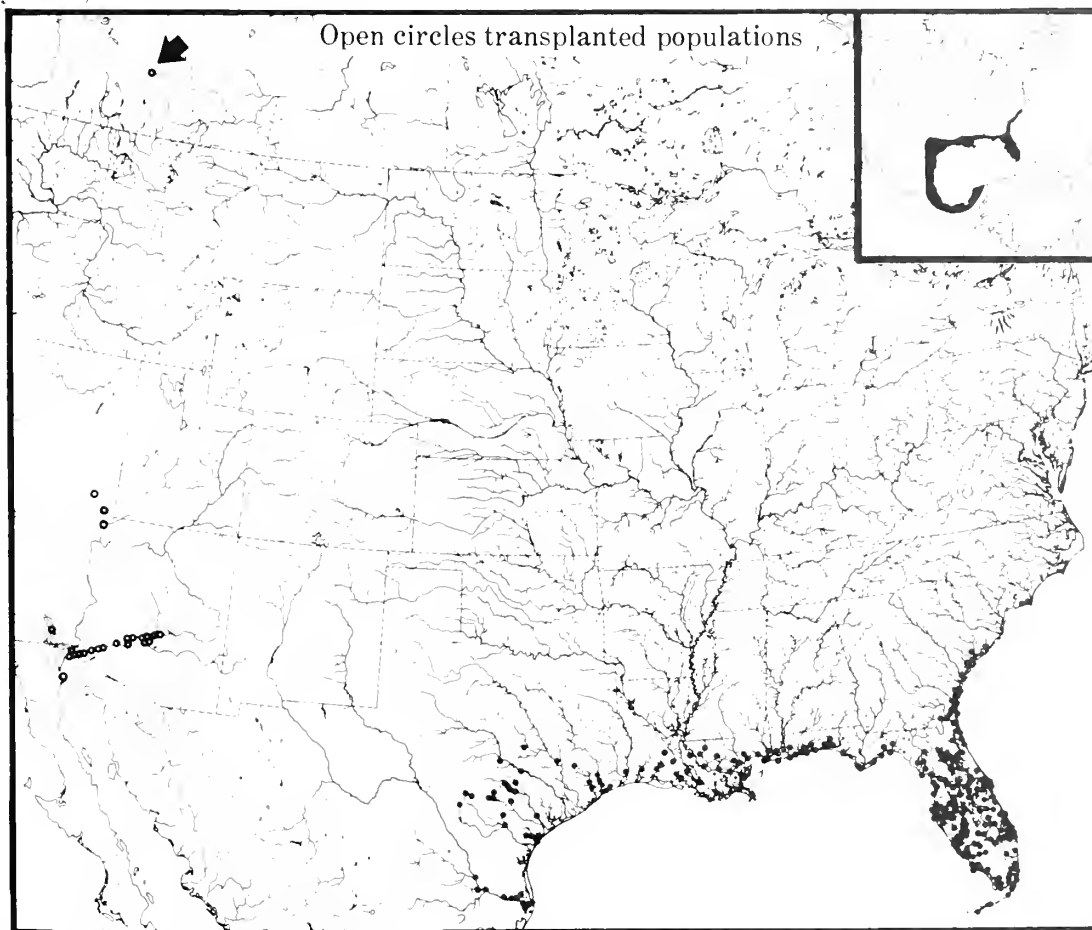
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Lake Pontchartrain, New Orleans, LA (Lesueur 1821, J. Acad. Nat. Sci. Phila. 2:2-8).

SYSTEMATICS: Subgenus *Poecilia*. Appears in earlier literature in genus *Mollienesia*, synonymized with *Poecilia* by Rosen and Bailey (1963, Bull. Mus. Nat. Hist. 126: 1-176). *Poecilia lincolata* is a synonym. *Poecilia latipinna* and allopatric forms *P. petenensis* and *P. velifera* may prove to be members of a single polytypic species (Rosen and Bailey 1963).



CA: Imperial Co., Salton Sea, male, 60 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Fresh, brackish, and salt waters along the coast, from southeastern NC to northwestern side of Yucatan peninsula, Mexico (Rosen and Bailey 1963). Extremely common in peninsular FL, where found in a wide variety of habitats, including springs, lakes and ponds, rivers and streams, drainage ditches, and salt marshes. Popular aquarium fish, frequently introduced in United States and other countries. Mollies in upper Guadalupe and San Marcos rivers, TX, once considered introduced (Hubbs et al. 1953, Tex. J. Sci. 5:216-44; Brown 1953, Tex. J. Sci. 5:245-51), but that view not subscribed to here.

ADULT SIZE: 15-51 mm SL (males), 19-53 mm SL (females); 150 mm TL maximum.

BIOLOGY: Feeds primarily on algae, vascular plants, organic detritus, and mosquito larvae (Harrington and Harrington 1961, Ecology 42:646-66; Minckley 1973, *Fishes of Arizona*). Live-bearer; courtship and copulation occur rapidly, female capable of storing sperm. Large female can produce up to 141 young (9-12 mm TL) in a brood (Moyle 1976, *Inland Fishes of California*). Snelson (1976, Final Rep. NASA, Grant NGR 10-019-004) summarized reproductive literature and reported on reproductive biology of an estuarine population.

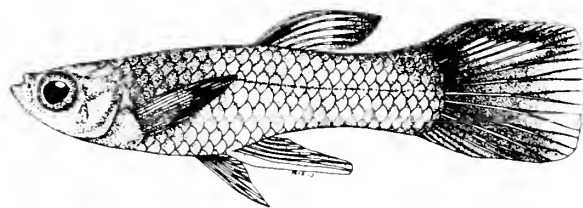
Compiler: G. H. Burgess, December 1978.

Poecilia reticulata Peters
Guppy

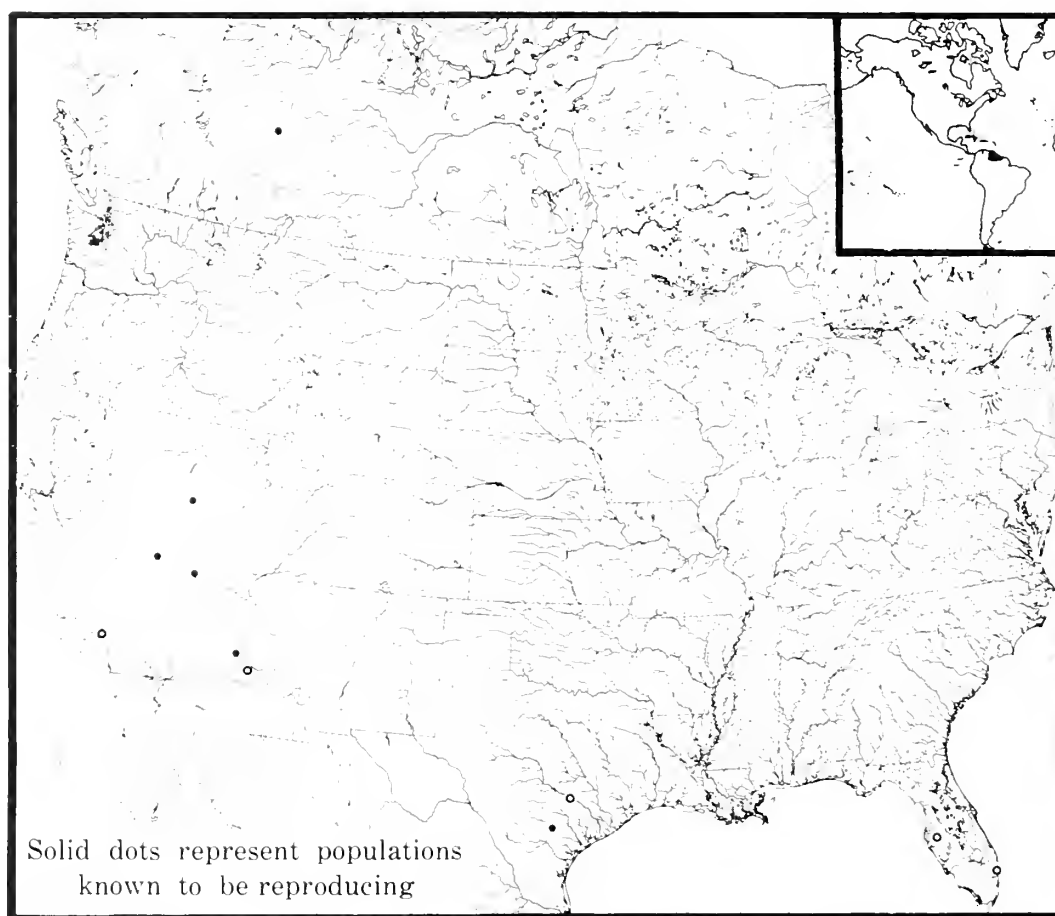
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Caracas, Venezuela (Peters 1859. Monatsber. K. Preussischen Akad. Wiss., Berlin:411-12).

SYSTEMATICS: In subgenus *Lebistes*. Systematics treated by Rosen and Bailey (1963. Bull. Am. Mus. Nat. Hist. 126:1-176). Included in keys to freshwater fishes of AZ by Minckley (1973. *Fishes of Arizona*) and CA by Moyle (1976. *Inland Fishes of California*).



FL: Palm Beach Co., male (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Netherlands Antilles, and the Venezuelan islands, Trinidad, the Windward (Barbados) and Leeward (St. Thomas and Antigua) islands, and from western Venezuela to Guyana; records from Lesser Antilles possibly due to introductions. Established in NV, AZ, TX, and AT possibly established in CA and FL. Abundant at AT locality. Population of *Crenichthys baileyi* at Preston Town Spring, White Pine Co., NV, adversely affected by establishment of *P. reticulata*. Introductions due to escapes from fish farms and releases by aquarists.

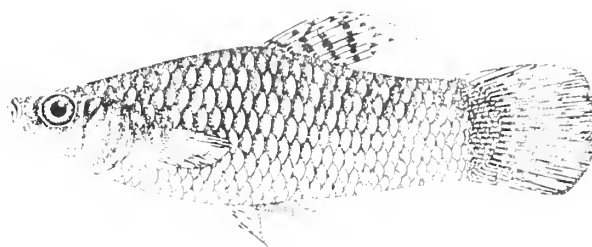
ADULT SIZE: Females 20-40 mm SL, males 15-20 mm SL, 50 mm SL maximum.

BIOLOGY: Feeds mainly on insect larvae. Exhibits female growth superiority and sexual dichromatism. Summary of literature on reproduction by Breder and Rosen (1966. *Modes of Reproduction in Fishes*). More recent literature cited and factors responsible for maintenance of polymorphism in male secondary sexual coloration studied by Farr (1977. *Evolution* 31: 162-68).

Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Poecilia "sphenops complex"
Shortfin molly

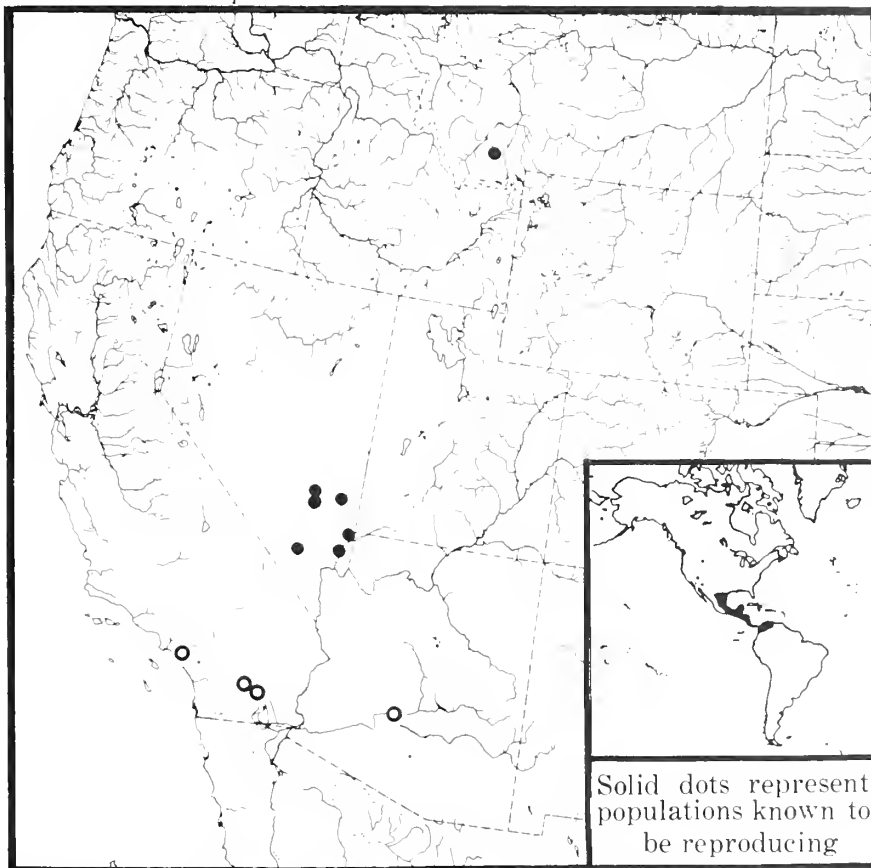
Order Atheriniformes
Family Poeciliidae



Mexico: Veracruz, 32 km
south of Veracruz City, male,
50 mm SL (FAU).

TYPE LOCALITY: For *P. sphenops*, near Veracruz, Mexico (Valenciennes in Cuvier and Valenciennes 1846. *Histoire Naturelle des Poissons* 18:1-508).

SYSTEMATICS: Treated here as a species complex since number and identity of introduced species is uncertain. Complex discussed by Rosen and Bailey (1963. *Bull. Am. Mus. Nat. Hist.* 126:1-176). Based on morphology and hybridization experiments, complex is composed of several distinct species (Schultz and Miller 1971. *Copeia*: 282-90). Species introduced into United States have appeared in literature as *P. sphenops*, *P. mexicana*, and *P. latipunctata*.



DISTRIBUTION AND HABITAT: Native distribution — For complex, in fresh and brackish coastal waters from northern Mexico to the Caribbean slope of Colombia and to the Netherlands and Colombian West Indies. Established in CA, MT, and NV. Has been collected in AZ and FL. Common at some United States localities. Establishment in NV has adversely affected populations of *Moapa coriacea* and *Crenichthys baileyi*; is a potential threat to other native fishes of the Pahranaagat Valley. Introductions into United States due to escapes and intentional releases from fish farms and releases of home aquarium fish.

ADULT SIZE: 30-50 mm SL, 100 mm SL maximum.

BIOLOGY: Population of *P. sphenops* in the Rio Tamesi system, Mexico, consumes detritus, filamentous algae, diatoms, desmids, and bits of vascular plant material by feeding from surfaces of rocks and other hard substrate (Darnell 1962. *Publ. Inst. Mar. Sci. Univ. Tex.* 8:299-365). Information on brood sizes given by Meyer (1938. *J. Genetics* 37:329-66) and Darnell (1962).

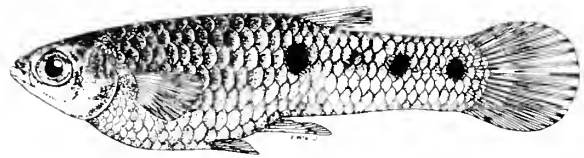
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Poeciliopsis gracilis (Heckel)
Porthole livebearer

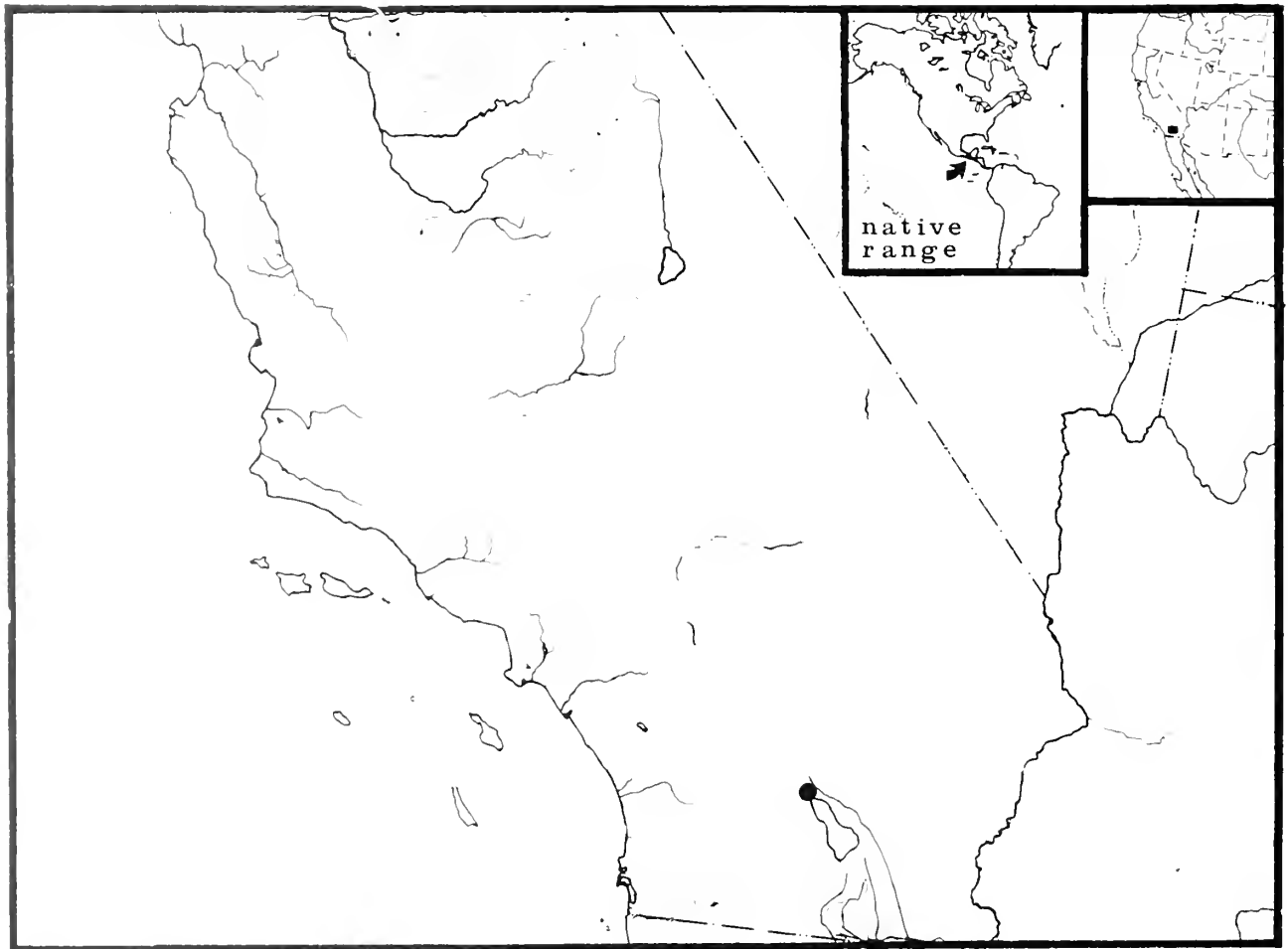
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Orizaba Mountains, Veracruz, Mexico (Heckel 1848. Sitzber. K. Akad. Wiss. Wien 1:289-303).

SYSTEMATICS: Subgenus *Poeciliopsis*. *Poeciliopsis pleurospilus* is a junior synonym (Rosen and Bailey 1963. Bull. Am. Mus. Nat. Hist. 126:1-176).



CA: Riverside Co., near Mecca, male, 21 mm SL (SIO).



DISTRIBUTION AND HABITAT: Native distribution — Freshwaters on Pacific and Atlantic slopes of Central America from southern Mexico to Honduras. Established in irrigation canal in Riverside Co., CA. Common. Introduction probably due to releases by aquarists or escapes from local fish farm.

ADULT SIZE: Females 50 mm SL maximum, males 40 mm SL maximum.

BIOLOGY: Most information on biology is from aquarium observations. Omnivorous. Spawning occurs at 25-28°C. Up to 40 young spawned over period of up to 10 days. Intervals between broods 10-12 days (Breder and Rosen 1966. *Modes of Reproduction in Fishes*; Jacobs 1971. *Live-bearing Aquarium Fishes*).

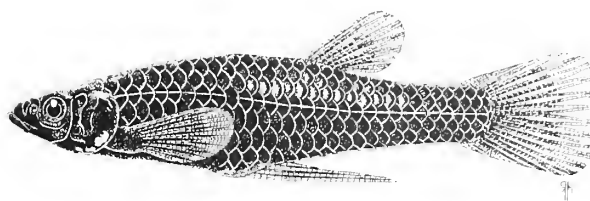
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Poeciliopsis occidentalis (Baird and Girard)
Gila topminnow

Order Atheriniformes
Family Poeciliidae

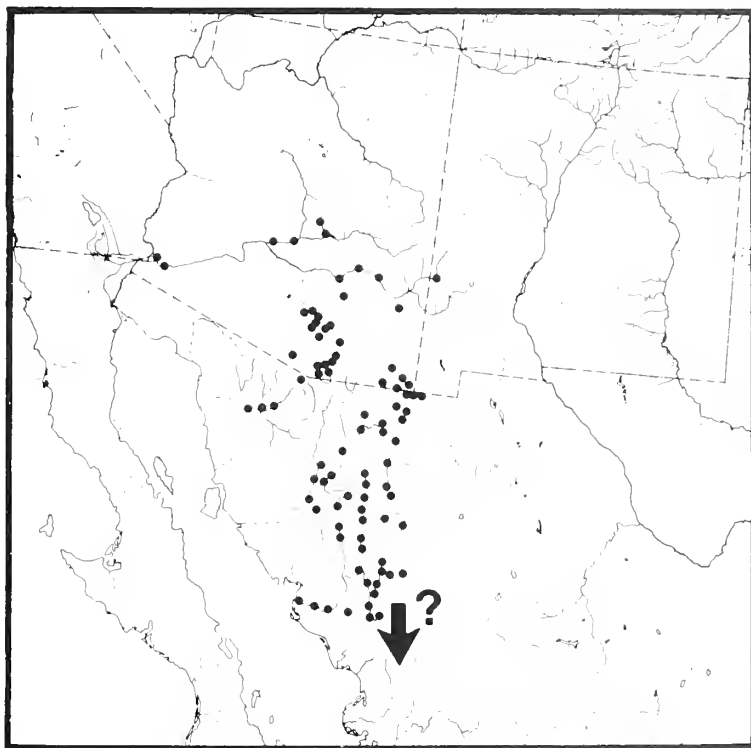
TYPE LOCALITY: Santa Cruz River, near Tucson, AZ (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. [1852-53] 6: 387-90).

SYSTEMATICS: Taxonomy uncertain in southern part of range. Northern forms with two recognized subspecies—*P. o. occidentalis* in Gila River basin, AZ, and *P. o. sonoriensis* in Rio Yaqui basin, AZ and northern Sonora, Mexico (McNatt 1974. Proc. West. Assoc. State Game Fish Comm. 54: 273-79). Participates in hybridogenesis of all-female forms of *Poeciliopsis* in southern river basins (Schultz 1977. in *Evolutionary Biology* 10: 277-331).



Mexico: Sonora, male (NCSM).

DISTRIBUTION AND HABITAT: Lowland and some upland streams of desert and grasslands, and margins of large, lowland rivers. Formerly common in streams and rivers below 1500 m in Gila River basin of AZ; one old record in NM (Frisco Hot Springs, Koster 1957. *Guide to the Fishes of New Mexico*). Now restricted in occurrence in United States (Minckley et al. 1977. U.S. For. Serv. Res. Pap. RM-198: 1-8), and classified as endangered by USDI (1976. Fed. Reg. 41[208]47180-198). Remains common in Rio Yaqui basin, Sonora, Mexico (Hendrickson et al. 1979. Rept. U.S. Fish Wildl. Serv., Albuquerque, NM), and presumably so farther south (Moore et al. 1970. *Evolution* 24:789-95). Typical inhabitant of vegetated springs, brooks, and margins and backwaters of larger bodies of water.



BIOLOGY: Bears young throughout year in constant temperature habitats at northern limits of range, and presumably does so in diverse habitats at southern limits. Otherwise exhibits prolonged, spring through summer reproduction, influenced by predation (which increases brood size) and nutrition (reproduction drops in food limited populations) (Schoenherr 1977. *Ecology* 58: 438-44). Feeds on detritus, algae, and aquatic invertebrates when available (Constantz 1974. *Southwest. Nat.* 19: 47-52). Introduced mosquito fish, *Gambusia affinis*, typically replaces this species when they come into contact, resulting in demise of Gila topminnow populations (Miller 1961. Pap. Mich. Acad. Sci. Arts Lett. 46:365-404; Minckley et al. 1977).

ADULT SIZE: Females usually no more than 50 mm SL, males rarely more than 30 mm, typically 20-25 mm SL.

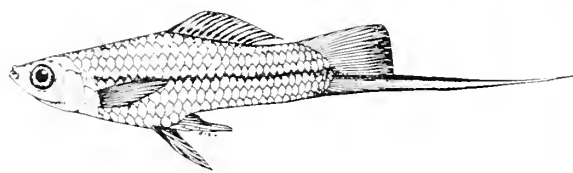
Compiler: W. L. Minckley. December 1979.

Xiphophorus hellerii Heckel
Green swordtail

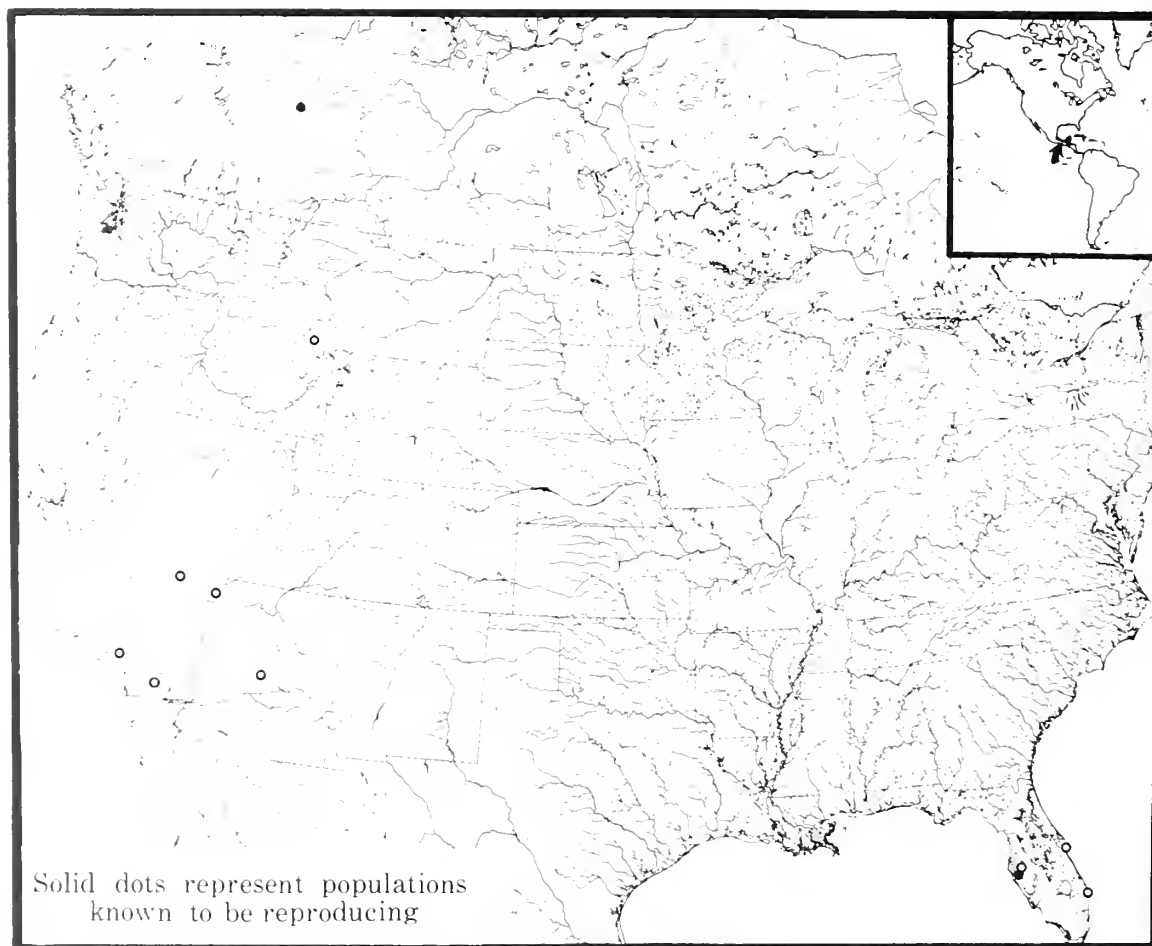
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Orizaba, Veracruz, Mexico; precise locality probably an error (Heckel 1848, Sitzber. K. Akad. Wiss. Wien 1:289-303).

SYSTEMATICS: In the species group containing *X. clemenciae* (Rosen 1960, Bull. Fla. State Mus. Biol. Sci. 5:57-242). Subspecies discussed by Rosen and Kallman (1969, Am. Mus. Novit. 2379:1-29). Included in keys to fishes of MT by Brown (1971, *Fishes of Montana*) and AZ by Minckley (1973, *Fishes of Arizona*).



FL: Hillsborough Co., male
(FAU).



DISTRIBUTION AND HABITAT: Native distribution — Usually lotic habitats on Atlantic slope from Rio Nautla, Veracruz, Mexico, to northwestern Honduras. Established in AT, MT, and FL. Previously established population near Rock Springs, Maricopa Co., AZ, is no longer extant. Has been collected in CA and NV. Apparently has little tolerance for brackish water. Abundant at some localities. Introductions into United States and Canada due to intentional and accidental releases by fish dealers and aquarists.

ADULT SIZE: In FL 17-38 mm SL, both sexes included.

BIOLOGY: Lower caudal rays of male elongated into "sword." Review of literature on reproduction and secondary sexual structures by Breder and Rosen (1966, *Modes of Reproduction in Fishes*).

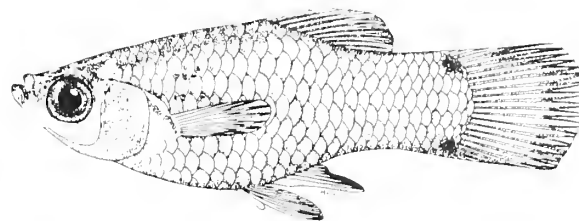
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Xiphophorus maculatus (Günther)
Southern platyfish

Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Mexico (Günther 1866, *A Catalogue of the Fishes in the British Museum* 6:1-368).

SYSTEMATICS: In species group containing *X. couchianus* and *X. variatus* (Rosen 1960, Bull. Fla. State Mus. Biol. Sci. 5: 57-242).



FL: Hillsborough Co., male
(FAU).



Solid dots represent populations
known to be reproducing

DISTRIBUTION AND HABITAT: Native distribution — Lentic habitats on Atlantic slope from just south of Veracruz City, Mexico to northern Belize. Established in Clark Co., NV, and Hillsborough and Palm Beach, FL. Has been collected in Orange Co., CA. Apparently has little tolerance for brackish water. In United States occurs only in isolated areas and is not abundant. Introduction into United States due to escapes or intentional releases from fish farms.

ADULT SIZE: In FL 17-30 mm SL, both sexes included.

BIOLOGY: Very variable in coloration. Extensive literature on reproduction, sexual dimorphism, and genetics reviewed by Breder and Rosen (1966, *Modes of Reproduction in Fishes*). More recent literature cited and mating patterns in natural populations studied by Borowsky and Kallman (1976, *Evolution* 30:693-706).

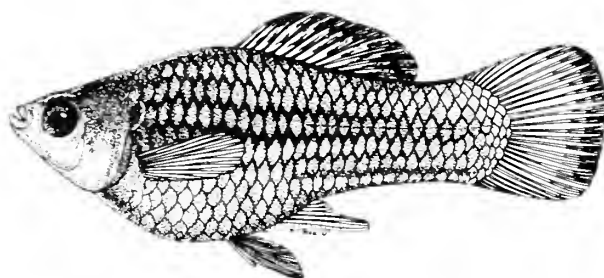
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Xiphophorus variatus (Meek)
Variable platyfish

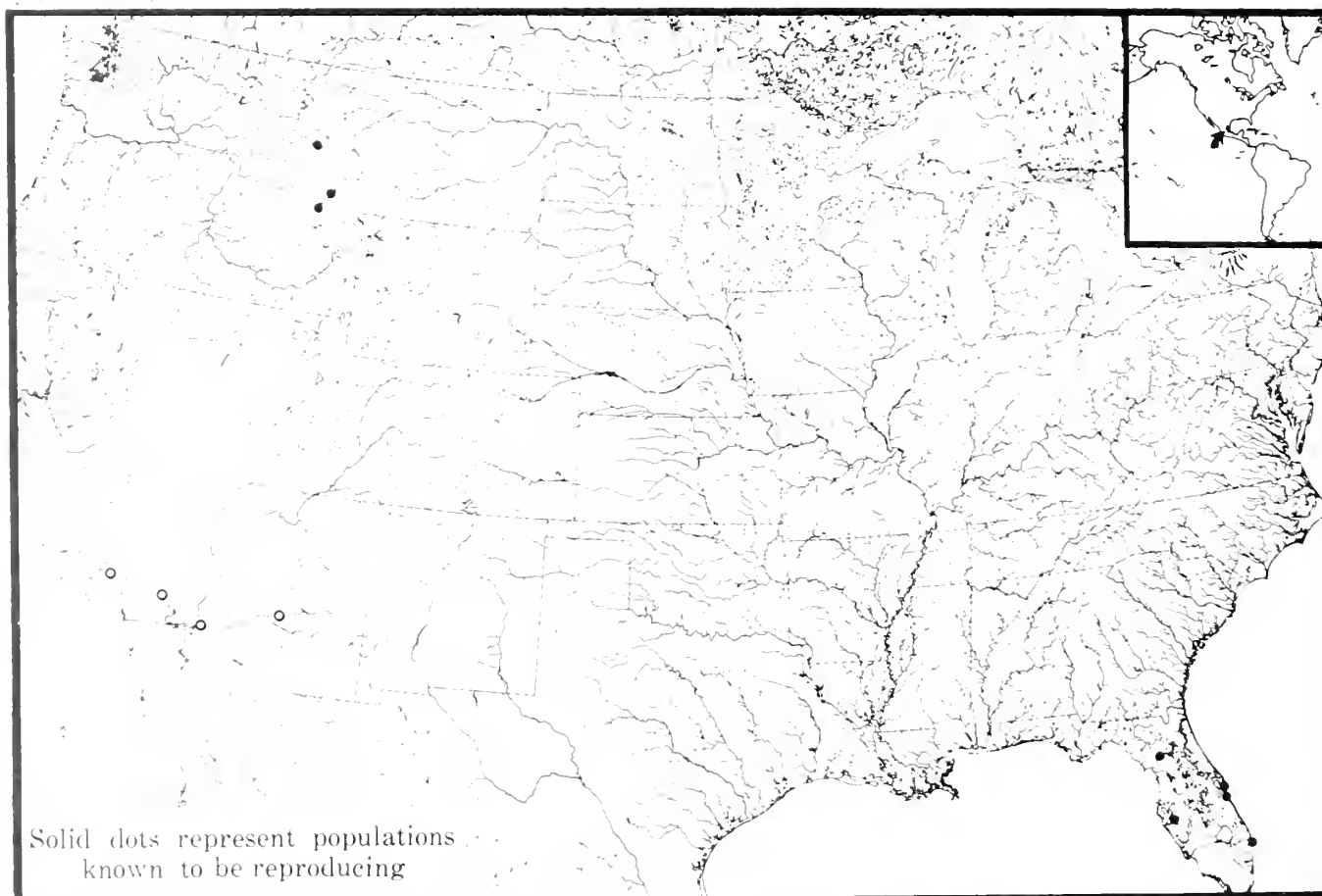
Order Atheriniformes
Family Poeciliidae

TYPE LOCALITY: Valles, San Luis Potosi, Mexico (Meek 1904. Field Columbian Mus. Publ. 93 Zool. Ser. 5:1-252).

SYSTEMATICS: In species group containing *X. couchianus* and *X. maculatus* (Rosen 1960. Bull. Fla. State Mus. Biol. Sci. 5:57-242). Included in keys to freshwater fishes of CA by Moyle (1976. *Inland Fishes of California*), AZ by Minckley (1973. *Fishes of Arizona*), and MT by Brown (1971. *Fishes of Montana*).



FL: Hillsborough Co., male (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Usually lentic habitats in southern Tamaulipas, eastern San Luis Potosi, and northern Veracruz, Mexico. Established in MT and FL. Populations in AZ and CA apparently are no longer extant. Has been collected from waters with low oxygen concentrations. Apparently has little tolerance for brackish water. In United States occurs only in isolated areas and is not abundant. Introductions into United States due to intentional or accidental releases from fish farms and releases of home aquarium fish.

ADULT SIZE: In FL 23-55 mm SL, both sexes included.

BIOLOGY: Feeds during day, primarily on mud or bottom ooze (Darnell 1962. Publ. Inst. Mar. Sci., Univ. Tex. 8:299-365). Literature on reproduction, sexual dimorphism, and genetics for genus reviewed by Breder and Rosen (1966. *Modes of Reproduction in Fishes*). Information on genetics and morphological variation given by Rosen (1960). More recent literature cited and mating patterns in natural populations studied by Borowsky and Khouri (1976. *Copeia*:727-34).

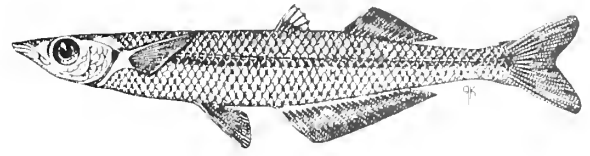
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

***Labidesthes sicculus* (Cope)**
Brook silverside

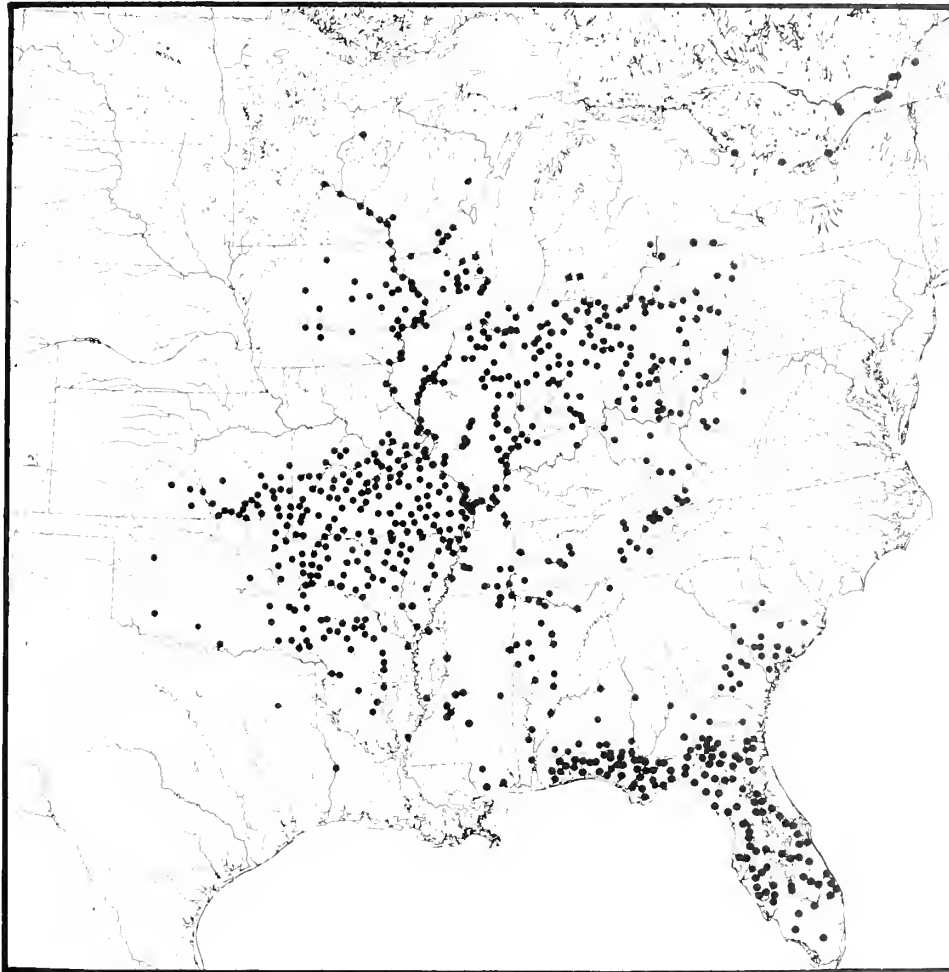
Order Atheriniformes
Family Atherinidae

TYPE LOCALITY: Grosse Isle, Detroit River, MI (Cope 1865. Proc. Acad. Nat. Sci. Phila. 17:78-88).

SYSTEMATICS: Monospecific genus. Detailed systematic study not yet published. Appears to be two valid forms (apparently subspecies), with nominate ranging from mid-Mississippi Valley north and subspecies *L. s. canhyningi* occurring in lower Mississippi Valley and along Gulf and southeast Atlantic coasts.



FL: Baker Co., south of
Macedlenny, 78 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Native to Mississippi and southern portions of Great Lakes basin, Gulf Coastal Plain from TX to FL, and on Atlantic slope north to SC. Stocked as forage fish within and outside natural range. Abundant near surface of clear, vegetated and unvegetated warm waters of streams, lakes, and reservoirs.

ADULT SIZE: 65-102 mm SL, 112 mm SL maximum.

BIOLOGY: Hubbs (1921. Ecology 2:262-76), Cahn (1927. Ill. Biol. Monogr. 11:1-151) and Nelson (1968. Trans. Am. Fish. Soc. 97:293-96) reported on life history and ecology. Keast and Webb (1966. J. Fish. Res. Board Can. 23:1845-74) studied food habits and noted it was a highly specialized feeder on cladocerans (to 80%), small flying insects (to 40%), and *Chaoborus* larvae (to 50%). Maximum life span about 17 months.

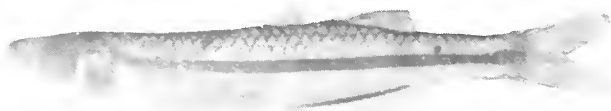
Compiler: D. S. Lee. June 1978.

Menidia beryllina (Cope)
Tidewater silverside

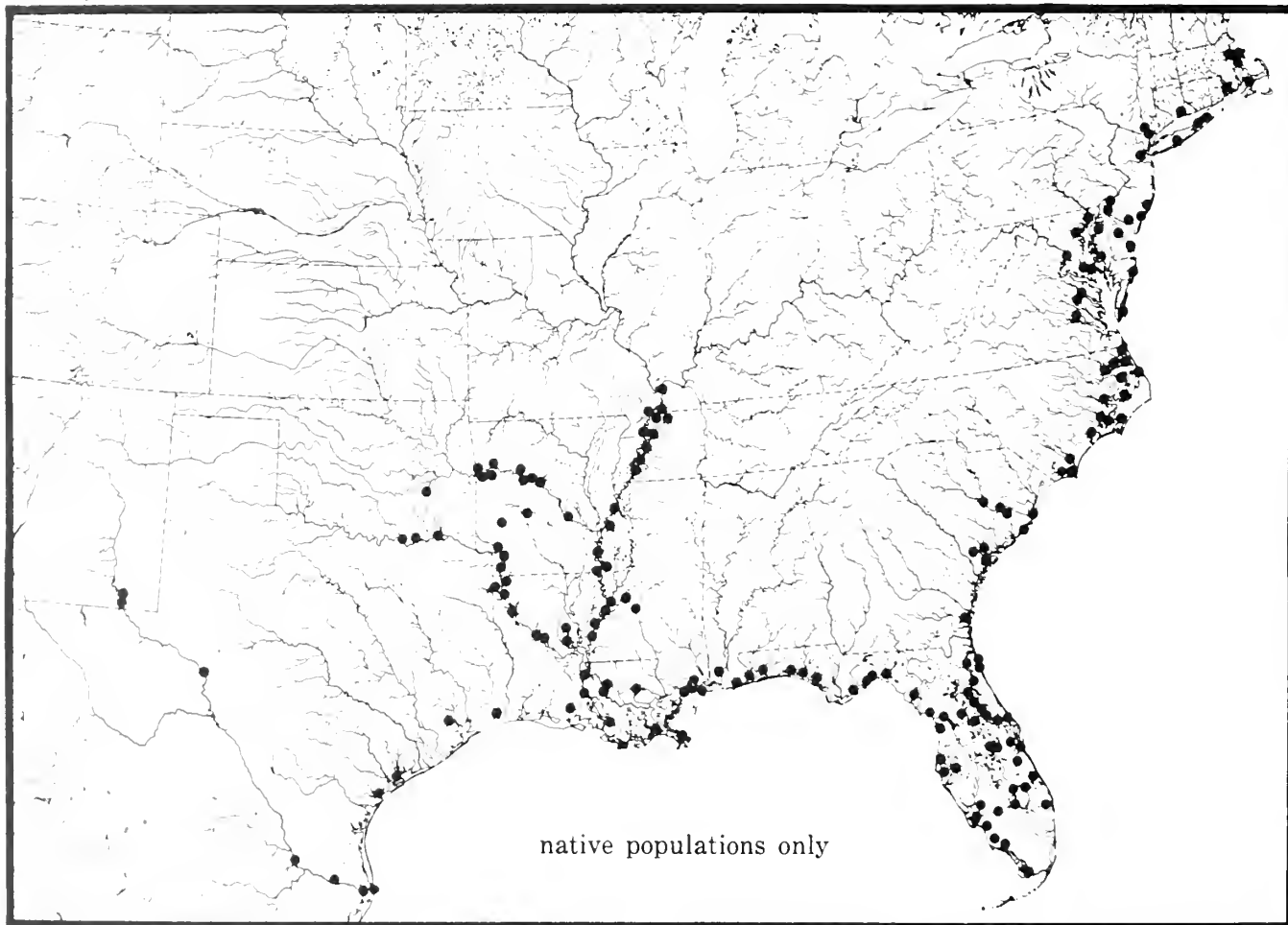
Order Atheriniformes
Family Atherinidae

TYPE LOCALITY: Potomac River, at Washington, D.C. (Cope 1869. Trans. Am. Philos. Soc. 13:400-07).

SYSTEMATICS: Systematics studied by Jordan and Hubbs (1919. Stanford Univ. Publ. [Univ. Ser.], Stud. Ichthyol.: 1-87); Robbins (1969. Ph.D. diss., Cornell Univ.); Johnson (Copeia 1975: 662-91); Chernoff et al. (1978. Abstr. 58th ASIH meeting). Only recently firmly distinguished from *M. peninsulae*. The nominal freshwater species, *M. audens*, has recently been synonymized with *M. beryllina* (Chernoff et al. 1978).



FL: Putnam Co., St. Johns River, 46 mm SL (NCSM).



native populations only

DISTRIBUTION AND HABITAT: Coastal and freshwater habitats, MA to southwestern Gulf of Mexico, and in Mexico at least as far south as Veracruz. Moves far up streams and rivers, particularly in southern parts of range. Some inland populations (e. g., in Arkansas River drainage, OK; Clear Lake, CA; and Stockton Reservoir, MO) likely introduced. In estuarine or freshwater situations, usually swimming at surface over sand and gravel bottom.

ADULT SIZE: 55-100 mm SL; 125 mm SL maximum.

BIOLOGY: Robbins (1969) summarized information on life history and ecology. Spawning is protracted, and several peaks are suggested. Food consists mostly of copepods, mysids, isopods, amphipods and insects. Lucas (1978. M. Sc. thesis, Univ. Florida) noted feeding partitioning between this species and *M. peninsulae*.

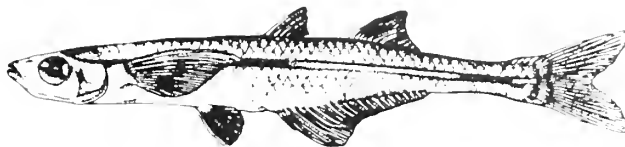
Compilers: C. R. Gilbert and D. S. Lee. July 1978.

***Menidia extensa* Hubbs and Raney**
Waccamaw silverside

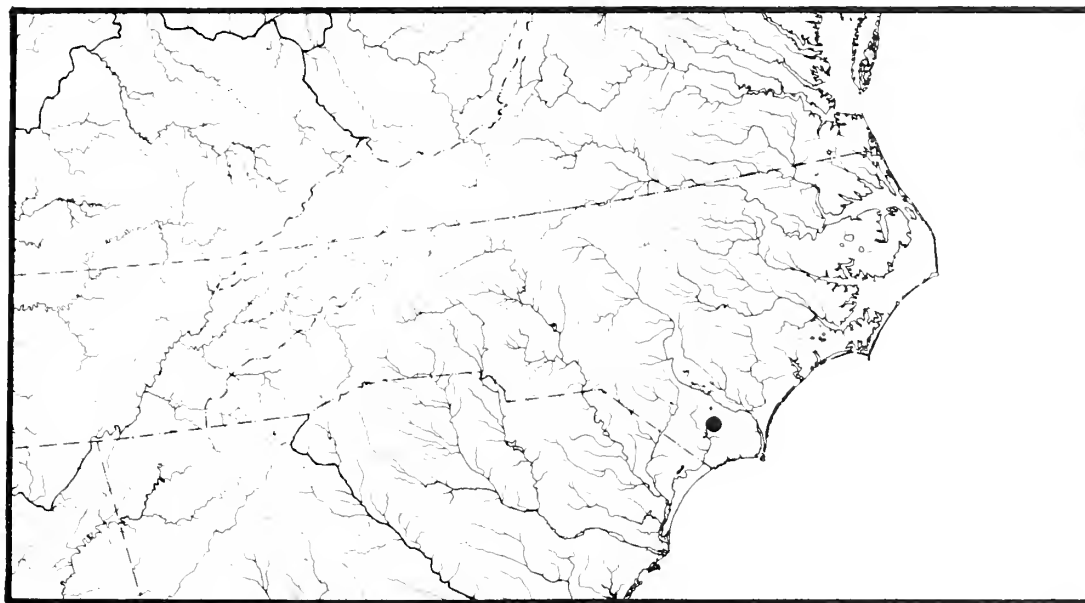
Order Atheriniformes
Family Atherinidae

TYPE LOCALITY: North shore of Lake Waccamaw, Columbus Co., NC (Hubbs and Raney 1946. Misc. Publ. Mus. Zool. Univ. Mich. 65: 1-30).

SYSTEMATICS: Freshwater derivative of *M. beryllina* stock (Gosline 1948. Evolution 2:306-13); evolved relatively rapidly and became quite distinct from latter (Johnson 1975. Copeia:662-91).



NC: Columbus Co., Lake Waccamaw, male, 66 mm SL (UNC-W).



DISTRIBUTION AND HABITAT: Endemic to Lake Waccamaw, a shallow Coastal Plain lake in southeastern NC. Large schools are commonly found near the surface in open waters over shallow, dark-bottomed areas throughout the lake.

BIOLOGY: Spawns in open waters after its first winter. Number of eggs per female averages 150. Only a small segment of population lives through second winter. Feeds primarily on zooplankton, with cladocerans abundant in stomachs throughout year (Davis and Louder 1969. Trans Am. Fish. Soc. 98:466-72).

ADULT SIZE: 30-66 mm SL.

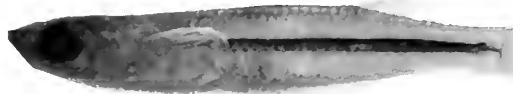
Compiler: P. W. Shute. June 1978.

Menidia menidia (Linnaeus)
Atlantic silverside

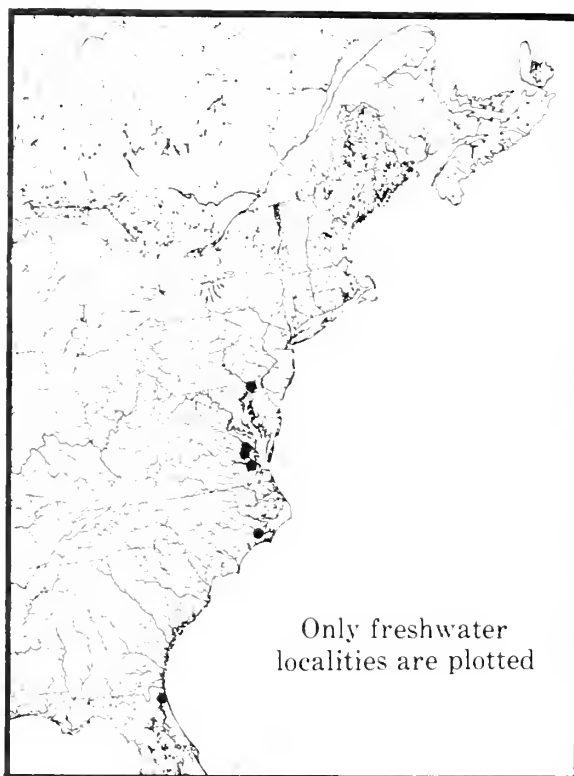
Order Atheriniformes
Family Atherinidae

TYPE LOCALITY: Charleston, SC (Linnaeus 1766. *Systema naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532).

SYSTEMATICS: Jordan and Hubbs (1919. Stanford Univ. Publ. Univ. Ser. 40:1-87) and Gosline (1948. *Evolution* 2:306-13) postulated two subspecies. Although species is meristically variable, electrophoretic data indicate little variation and lack of divergence (Johnson 1974. *Evolution* 28: 607-718). Phylogenetically separated from other members of the genus, but most closely related to *M. peninsulae* with which it hybridizes in northern FL (Johnson 1975. *Copeia*: 662-91).



GA: St. Simon's Island,
66 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Johnson (1975) recorded range as United States east coast (near-shore), from NF to northern FL. Tabb and Manning (1961. *Bull. Mar. Sci.* 11:552-649), however, stated that species is "the common silverside of higher salinities in Florida Bay," which seems to be southernmost occurrence. Common year around in higher salinity areas, entering brackish (and occasionally fresh) waters. Generally pelagic and travels in variable sized schools. Seems to prefer shallow, sandy areas, but also frequents grass beds. May move to deeper waters during winter.

ADULT SIZE: 90 mm TL (140 mm TL maximum).

BIOLOGY: Spawns April to August, usually in vicinity of grass beds (Smith 1907. *Fishes of North Carolina*; Hildebrand and Schroeder 1928. *Bull. U.S. Bur. Fish.* 43: 1-388; Bigelow and Schroeder 1953. *Fish. Bull.* 53:1-577; Leim and Scott 1966. *Bull. Fish. Res. Board Can.* 155:1-485; Breder and Rosen 1966. *Modes of Reproduction in Fishes*; Wang and Kernehan 1979. *Fishes of the Delaware Estuaries*). Hildebrand (1922. *Bull. U.S. Bur. Fish.* 38:113-20.) described spawning, eggs, and larvae from Beaufort, NC area. Feeds mainly on crustaceans and annelids, but also may eat molluscs, fish eggs, plants, squid, and insects. May live at least two years (Leim and Scott 1966.).

Compiler: S. W. Ross. December 1979.

Apeltes quadracus (Mitchill)
Fourspine stickleback

Order Gasterosteiformes
Family Gasterosteidae

TYPE LOCALITY: New York (Mitchill 1815, Trans. Philos. Soc. N.Y. 1:355-492).

SYSTEMATICS: Wootton (1976, *The Biology of Sticklebacks*) discussed comparative evolutionary relationships of family. Krueger (1961, *Copeia* :442-50) and Coad and Power (1973, *Naturiste Can.* 100:247-51) described meristic variation.



MA: Woods Hole (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Generally confined to marine and estuarine waters of Atlantic coast from north shore of Gulf of St. Lawrence to Trent River, NC (Rohde et al., in prep.). A few populations known from far upstream in Hudson, Delaware, and Susquehanna drainages, and other isolated freshwater situations (Coad and Power 1973). Abundant in grass flats in summer and channels in winter. Has greater range of salinity tolerance than other North American sticklebacks (Nelson 1968, *Can. J. Zool.* 46:663-67).

ADULT SIZE: 33-49 mm SL.

BIOLOGY: Coad and Power (1973) studied isolated freshwater population. Three age groups found, but only females survived into third year. Food consisted of chironomid and ephemeropteran larvae, and cladocerans. Breeding occurred in June and July. Females contained 10-19 ova (diameters: 0.54-0.89 mm), with older fish more fecund. Reproductive behavior and nest construction described by Reisman (1963, *Copeia* :191-92) and Rowland (1974, *Copeia* :183-94; 1974, *Copeia* :788-89). Tyler (1963, *Chesapeake Sci.* 4:105-06) noted captive individuals removing ectoparasites from *Lucania parva*.

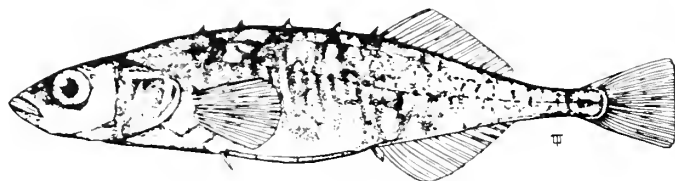
Compilers: G. H. Burgess and D. S. Lee.
October 1978.

Culaea inconstans (Kirtland)
Brook stickleback

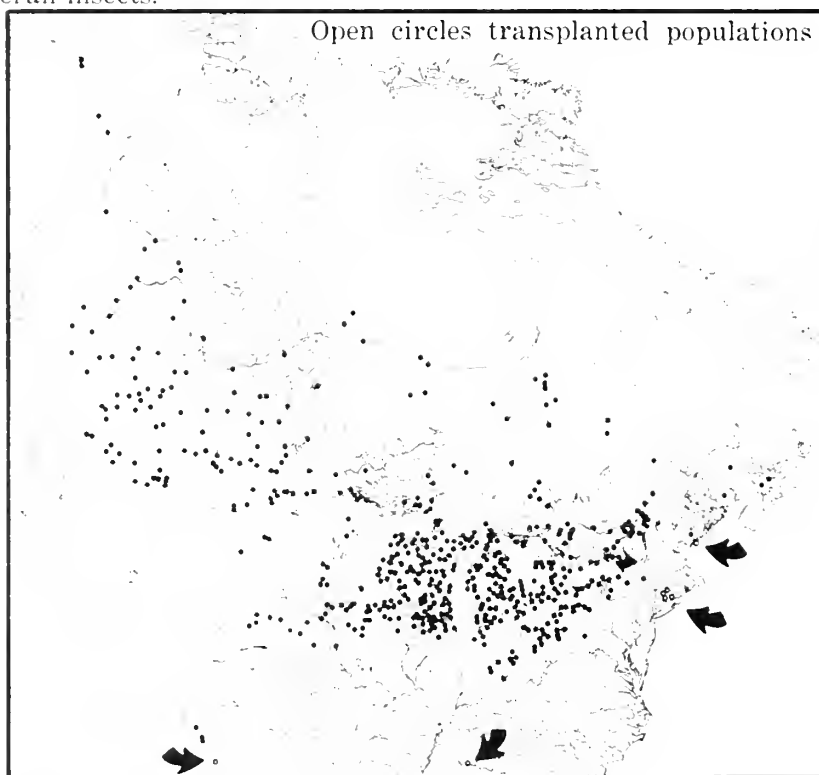
Order Gasterosteiformes
Family Gasterosteidae

TYPE LOCALITY: "Ditches and muddy pools of Trumbull Co., OH" (Kirtland 1841. Boston J. Nat. Hist. [1840-41] 3:273-79).

SYSTEMATICS: Wootton (1976. *The Biology of Sticklebacks*) discussed systematics. Nelson (1969. J. Fish Res. Board Can. 26: 2431-47) noted clinal variation in dorsal and pelvic spine lengths. Generic name *Culaea* introduced by Whitley (1950. Proc. R. Zool. Soc. N. S. W. [1948-49]:44), who showed previous name *Eucalia* preoccupied in group of lepidopteran insects.



(NMC)



DISTRIBUTION AND HABITAT: Nova Scotia west to IA, NB, and MT; north, in Canada, to BC, southern NT (vicinity of Great Slave Lake), and lower Hudson Bay. Apparent relict population known from northeastern NM (Koster 1957. *Guide to the Fishes of New Mexico*; Nelson 1969), possibly introduced into CT (Whitworth et al. 1968. *Freshwater Fishes of Connecticut*), and obviously introduced into AL (Smith-Vaniz 1968. *Freshwater Fishes of Alabama*). Prefers cool, clear, heavily weeded, spring-fed streams and ponds. Usually in shallow water, but sometimes in much deeper situations, as attested by capture in trawl hauls in Lake Huron at depths of nearly 55 m (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Occasionally in brackish water, but unable to tolerate salinities greater than 21 ppt. (Nelson 1968. Can. J. Zool. 46:663-67).

ADULT SIZE: 40-60 mm SL, ca. 75 mm SL (87 mm TL) maximum.

BIOLOGY: Considerable information available on nearly all aspects of biology. Winn (1960. Am. Midl. Nat. 63:424-38) and Thomas (1962. Am. Zool. 2:452) gave accounts of spawning and behavior. Scott and Crossman (1973) and Wootton (1976) provided literature reviews. Spawns in shallow water, late April to August, in northern latitudes at temperatures from 8-19°C. Male builds nest of twigs and vegetation, and after eggs are laid assumes all subsequent care of both eggs and young. Feeds on larvae of aquatic insects and crustaceans, eggs and larvae of fishes, snails, oligochaetes, ostracods, and algae. Sexual maturity attained in one year. Probable maximum life span one, at most two, years.

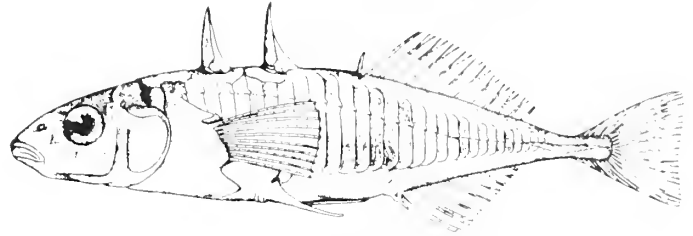
Compilers: D. S. Lee and C. R. Gilbert. February 1978.

***Gasterosteus aculeatus* Linnaeus**
Threespine stickleback

Order Gasterosteiformes
 Family Gasterosteidae

TYPE LOCALITY: Europe (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10ed., 1:1-824).

SYSTEMATICS: Represents complex of forms that has received considerable systematic attention in recent years (see Bell 1977. *Copeia*: 2:277-82). Hagen (1967. *J. Fish. Res. Board Can.* 24:1637-92) found that "trachurus" (fully plated, marine) and "leiurus" (weakly plated, freshwater) forms hybridized in narrow zone in Little Campbell River, BC, resulting in "semiarmatus" form. He proposed full specific status for each, as *G. trachurus* and *G. aculeatus*, respectively. Miller and Hubbs (1969. *Copeia*: 52-69) argued for retention of both types in *aculeatus*, and used subspecific names *aculeatus*, (for "trachurus"), *microcephalus* (for "leiurus"), and *williamsoni* (for southern CA, plateless freshwater form). Hagen and McPhail (1970. *J. Fish. Res. Board Can.* 27:147-55) stated that Miller and Hubbs' evidence for introgression not well established, and that much of interpopulation variation is result of adaptation and natural selection. Moodie and Reimchen (1976. *Syst. Zool.* 25:49-61) described populations from Queen Charlotte Islands that may require taxonomic recognition. Taxonomic status of disjunct Pacific, Atlantic North American, and Atlantic European population also not yet addressed. Appears some doubt of complex ever fitting into present biological species concept.



ON: Lake Erie, Pelee Island (NMC).



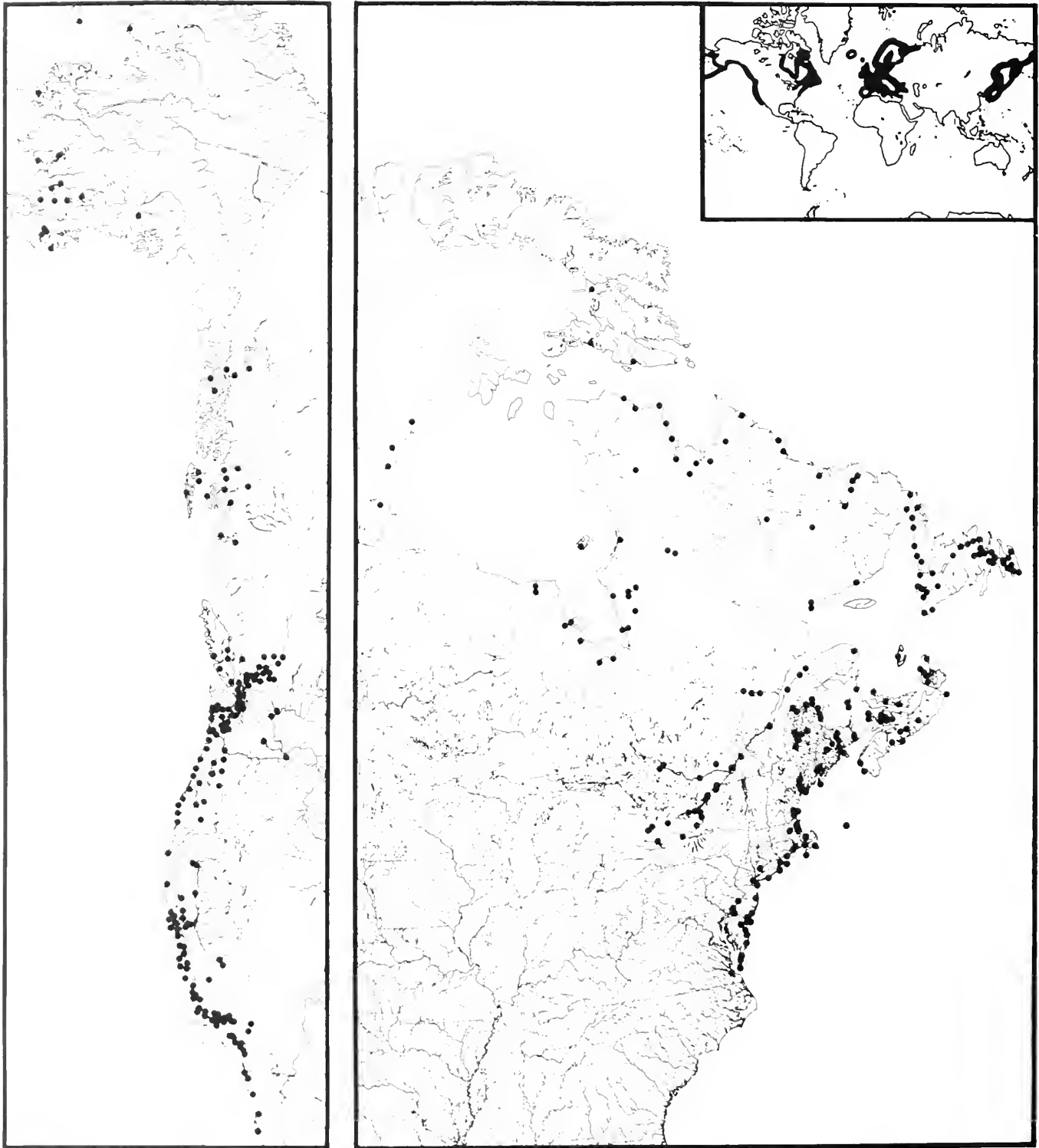
See map on next page

DISTRIBUTION AND HABITAT: Nearly circumpolar and widely distributed in northern hemisphere in marine and fresh waters. European distribution mapped by Wootton (1976. *The Biology of Sticklebacks*). In North America ranges from Chesapeake Bay to Hudson Bay and Baffin Island in Atlantic, and from Rio Rosario, Baja California, to Seward Peninsula and Aleutian Islands, AK, in Pacific. Freshwater populations found far inland along Atlantic coast (especially in ME and NB), and species recorded throughout Lake Ontario and Ottawa and St. Lawrence rivers. DeKay (1842. *Natural History of New York*, I. Zoology, 4. Fishes) reported it from Hudson River at Albany, but it has not been taken subsequently. Common in nearshore shallows, especially in grass.

ADULT SIZE: 30-75 mm TL, 102 mm TL.

BIOLOGY: One of best studied fishes. Wootton's (1976) comprehensive review of biology includes chapters on development and growth, feeding and digestion, parasites and predators, migration and osmotic regulation, reproduction, and reproductive behavior. Shorter biological reviews included in Carlander (1969. *Handbook of Freshwater Fishery Biology* Vol. 1) and Scott and Crossman (1973. *Freshwater Fishes of Canada*).

Compilers: G. H. Burgess and D. S. Lee.
 October 1978.



Distribution of threespine stickleback, *Gasterosteus aculeatus*

Gasterosteus wheatlandi Putnam
Blackspotted stickleback

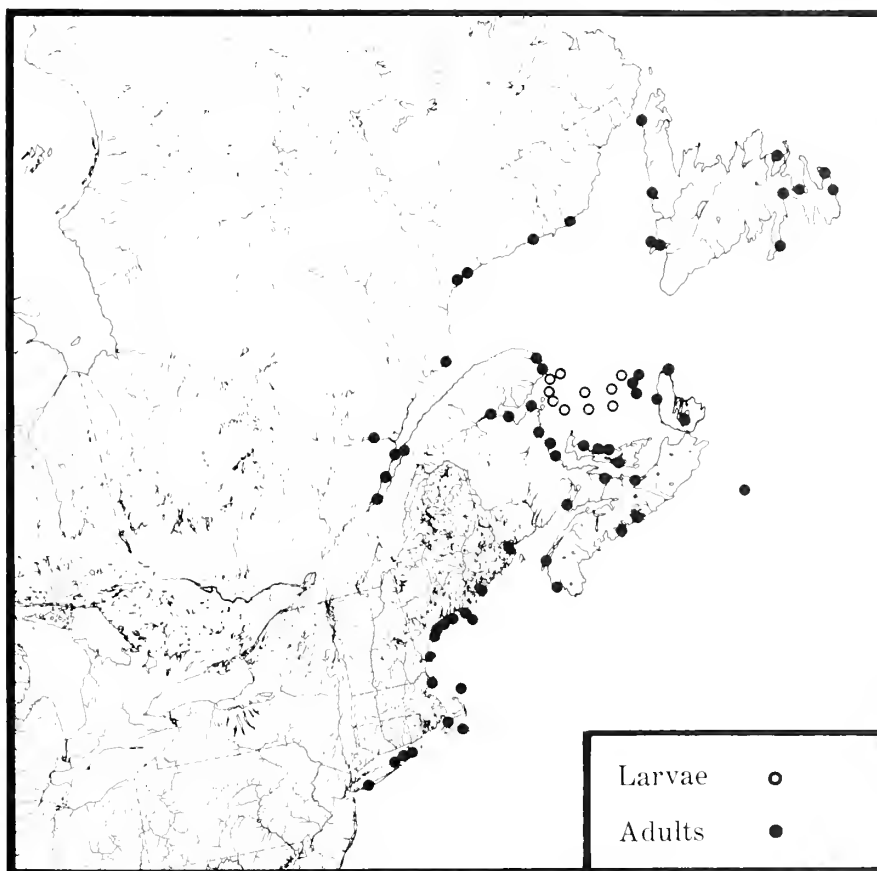
Order Gasterosteiformes
Family Gasterosteidae

TYPE LOCALITY: Nahant, Essex Co., MA
(Putnam 1866, Proc. Essex Inst. 5:4).

SYSTEMATICS: Described several times but confused with *G. aculeatus* until distinguishing features delineated by Hubbs (1929, Occas. Pap. Mus. Zool. Univ. Mich. 200:1-9).



(Laboratoires de Recherches
Ministère du Tourisme, de la
Chasse et de la Pêche).



DISTRIBUTION AND HABITAT: Western Arm Brook, north of St. Barbe, NF, at 51° 13 1/2'N, 56° 47'W, south to Jones Beach Inlet, southwest Long Island, Nassau Co., NY (AMNH 36505); from near Quebec City in west to eastern NF and Sable Island, NS in east, along coast in salt and brackish water, occasionally (McAllister 1960, Can. Field-Nat. 74:177-78) in fresh water. Van Vliet (1970, Publ. Zool. Nat. Mus. Can. 3:1-30) reported it in salinities from 0-33.5 ppt and temperatures from 7-18.5°C. Most often in estuarine conditions over sand, mud or rubble bottom, associated with eel grass or other vegetation. Reported from Anticosti Island without precise locality (Scott and Crossman 1973, *Freshwater Fishes of Canada*).

ADULT SIZE: 20-50 mm SL, maximum 76 mm TL.

BIOLOGY: Lives in coastal waters entering brackish creeks, streams, and tidal pools to spawn in late spring, when male assumes gold color with orange pelvics. Nest built of thread-like algae in water up to 60 cm deep at low tide. The 75-272 (0.8-1.5 mm) eggs are fertilized, guarded, and fanned by the male. Breed at one year of age and may survive a few months after. Life history by McInerney (1969, J. Fish. Res. Board Can. 26:2061-75) and Coad and Power (1973, Can. Field-Nat. 87:113-22).

Compiler: D. E. McAllister and B. Parker.
September 1978.

Pungitius pungitius (Linnaeus)
Ninespine stickleback

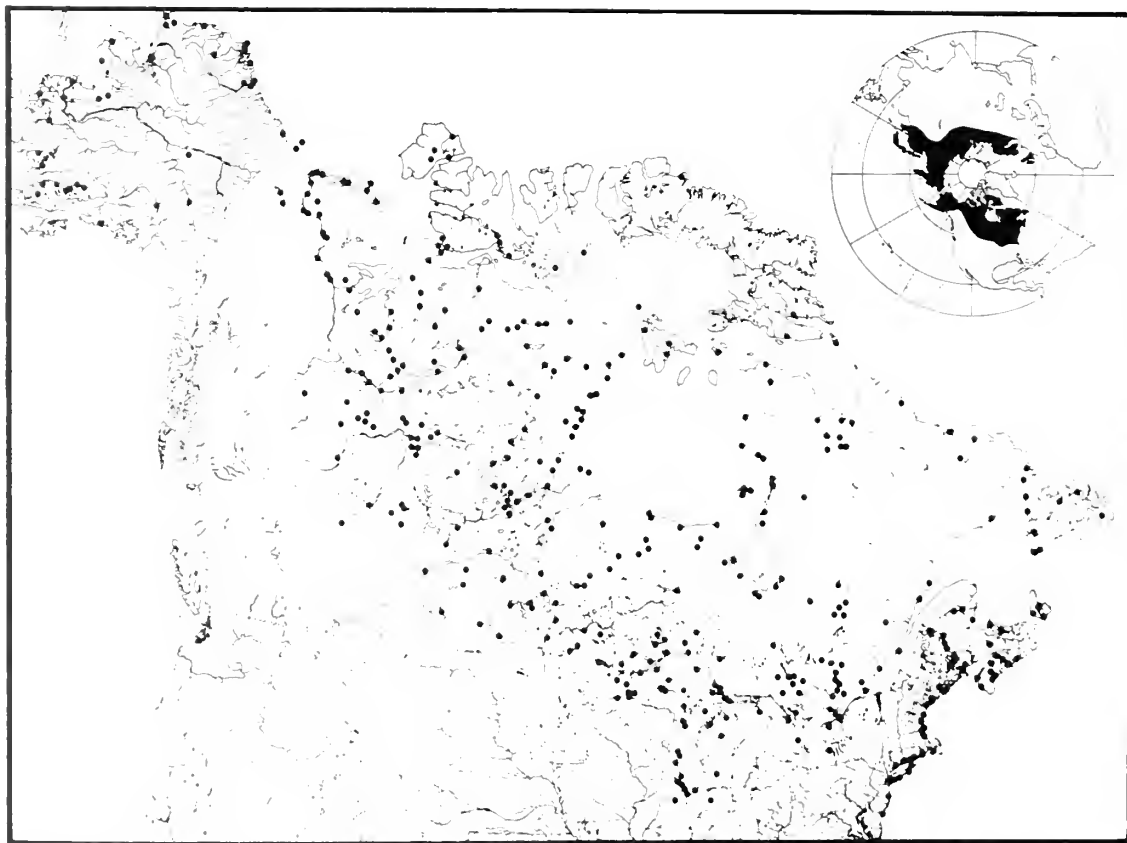
Order Gasterosteiformes
Family Gasterosteidae

TYPE LOCALITY: "Europe" (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10th ed., 1:1-824).

SYSTEMATICS: Lindsey (1962. Can. J. Zool. 40:1237-47) showed *Pungitius* has priority over *Pygosteus*, generic name commonly used by European workers. Wootton (1976. *The Biology of Sticklebacks*) discussed taxonomy and biology of species and subspecies of *Pungitius*. McPhail (1963. J. Fish. Res. Board Can. 20:27-44) described two Nearctic forms: a coastal form with more numerous dorsal spines and lateral plates and fewer gill rakers, from AK east and south along coast to NJ, which probably survived glaciation in Beringia; and an inland form ranging from Great Lakes northwest through Hudson Bay and Arctic drainages (except



NT: southern Baffin Island,
57 mm SL (NMC).



for coast) to MacKenzie basin, which survived in a Mississippian refugium. He did not consider them worthy of subspecific status.

DISTRIBUTION AND HABITAT: British Isles, northern Europe (and Black, Caspian, and Aral basins if *P. platygaster* regarded subspecies), northern USSR and Siberia south to Japan and Korea; across North America from AK to IN, NF, Sable Island, NS, and NJ; not in southern tip of Greenland. Generally prefers habitats with thicker vegetation than threespine stickleback, and tolerates lower oxygen tensions but not at high salinities.

ADULT SIZE: 40-50 mm TL.

BIOLOGY: In lakes and streams, and near coastal waters. Both forms breed in fresh water in summer when male constructs nest by gluing together bits of vegetation. Male fans eggs and guards young. Lives to about 3.5 years of age. Feeds on aquatic insects and small crustaceans and serves as food for pike, brook trout, lake trout, arctic char, grayling, yellow perch, walleye and burbot. Biology summarized in Wootton (1976).

Compilers: D. E. McAllister and B. Parker.
September 1978.

Oostethus brachyurus (Bleeker)
Opossum pipefish

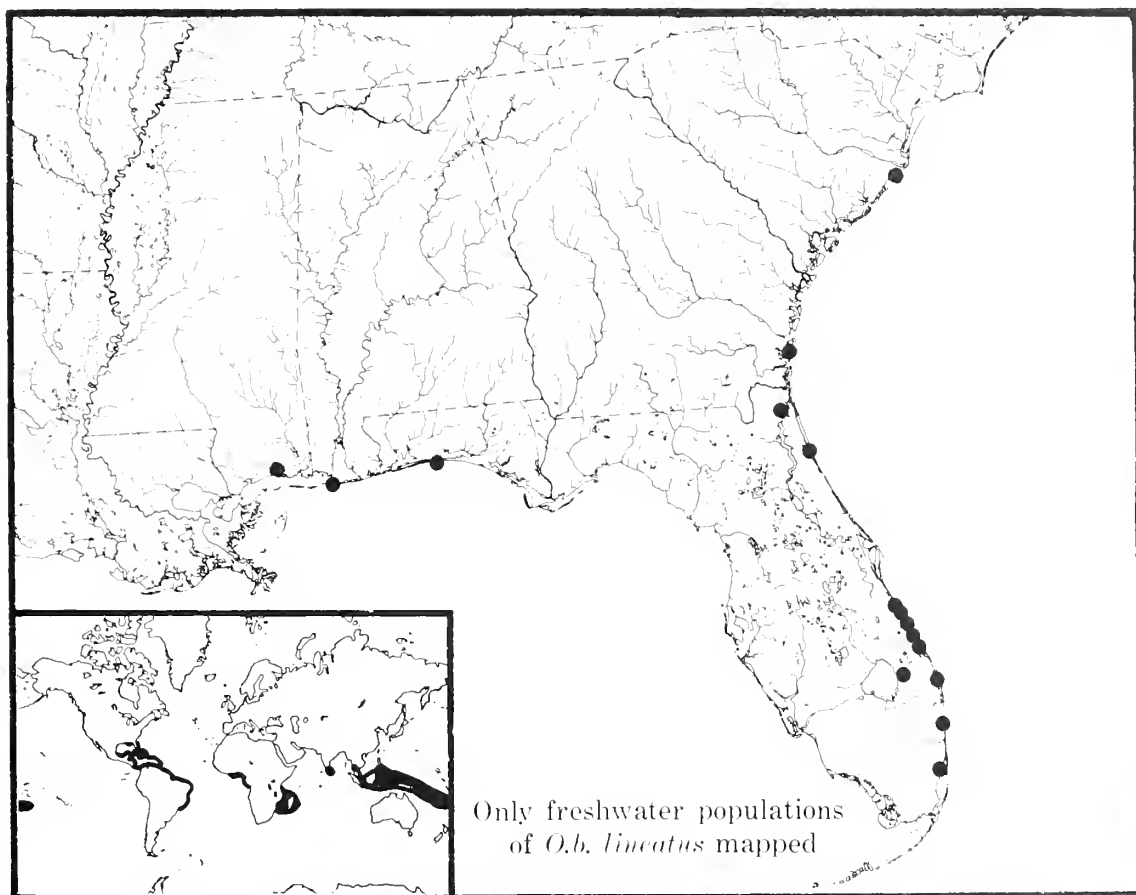
Order Gasterosteiformes
Family Syngnathidae

TYPE LOCALITY: Batavia, Java, Sumatra
(Bleeker 1853, Ver. Bat. Gen. 26:1-30).

SYSTEMATICS: Dawson (1979) reviewed this polytypic doryrhamphine species and recognized four allopatric subspecies. Form occupying western Atlantic and Pacific Panama is *O. b. lineatus*.



FL: Duval Co., San Carlos
Creek, 180 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Common in fresh and brackish waters of Central America but rare in United States, where it is known from McClellanville, SC (Fowler 1945, Acad. Nat. Sci. Phila. Monogr. 7:1-408) to Palm Beach, FL (Herrema 1974, M. Sc. thesis, Florida Atlantic Univ.), and Biloxi, MS (Dawson 1970, Copeia:772-73) to Destin, FL (Hastings and Bortone 1976, Fla. Sci. 39:123-25). Not uncommon in freshwater tributaries of Indian River lagoon, FL (Gilmore 1977, Copeia:781-83; pers. comm.).

BIOLOGY: Little known. Brooding adults found in fresh or low salinity waters (McLane 1955, Ph.D. diss., Univ. Florida; Gilmore 1977) and young apparently move or are carried into more saline waters after birth (Gilbert and Kelso 1971, Bull. Fla. State Mus. Biol. Sci. 16:1-54; Gilmore 1977). In United States waters brooding adults captured from July to November (McLane 1955; Dawson 1970; Gilmore 1977). Gilmore (1977) illustrated a 5.6 mm TL larva.

Compiler: G. H. Burgess, October 1978.

Syngnathus scovelli (Evermann and Kendall)
Gulf pipefish

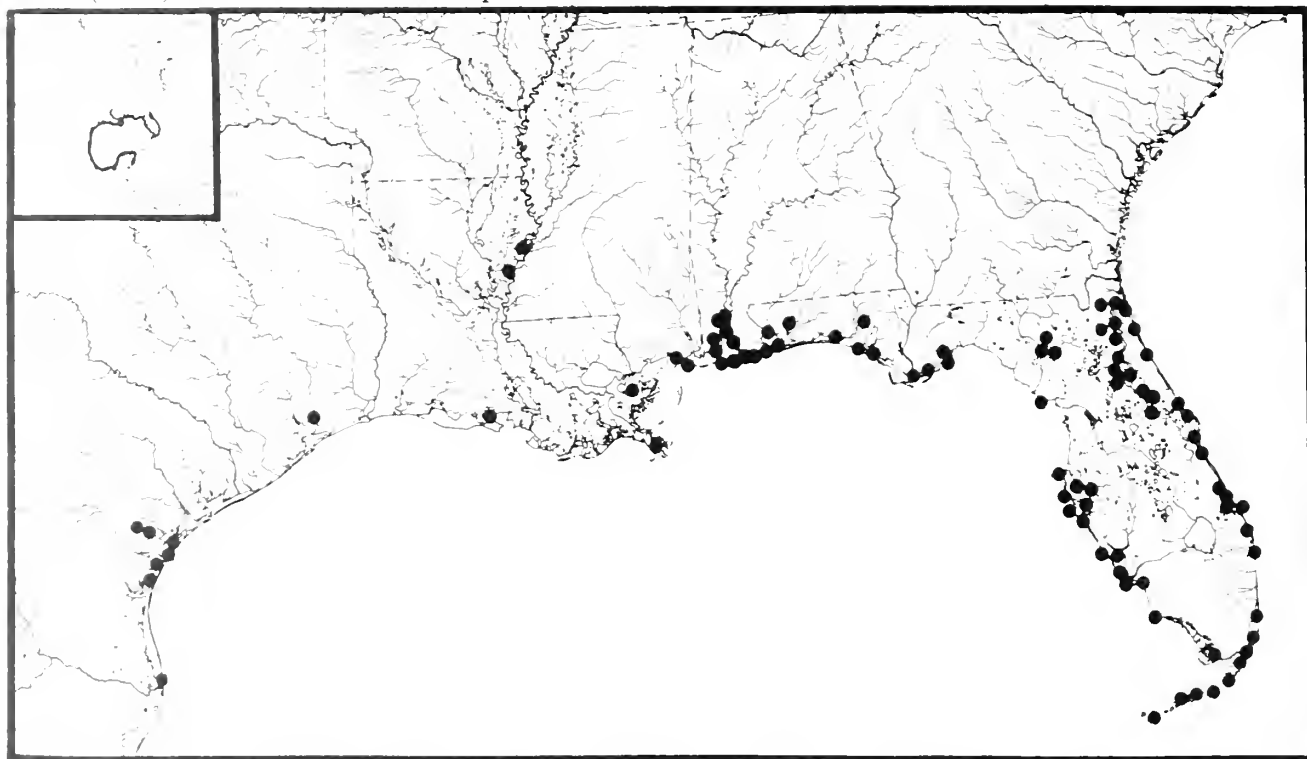
Order Gasterosteiformes
Family Syngnathidae

TYPE LOCALITY: Shamrock Point, Corpus Christi, TX (Evermann and Kendall 1896. Proc. U.S. Natl. Mus. [1895] 18:113-15).

SYSTEMATICS: Two subspecies, *S. s. scovelli* and *S. s. makayi*, described, the latter a dwarf form from Isla Mujeres, Mexico (Herald and Dawson 1972. Copeia: 781-84). Joseph (1957. Ph.D. diss., Florida State Univ.) and Brown (1972. Ph.D. diss., Univ. Florida) studied geographic variation. Brown (1972) described sexual dimorphism.



FL: Putnam Co., Orange Point, 114 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Euryhaline species ranging from mouth of St. Johns River, FL, south around coasts of FL and Gulf of Mexico to Yucatan peninsula and Mexican territory of Quintana Roo (Herald and Dawson 1972). Reproducing freshwater populations known from Sante Fe (Hellier 1967. Bull. Fla. State Mus. Biol. Sci. 11:1-46) and lower St. Johns (Tagatz 1968. J. Fla. Acad. Sci. [1967] 30:25-50) rivers in FL, and lakes St. John and Bruin, LA (Whatley 1969. Gulf. Res. Rep. 2:437-74). Mettee (1970. M.S. thesis, Univ. Alabama) reported single specimen from Blue Lake, Washington Co., FL. Common in seagrass in shallow and deep flats in marine situations, and among submergent vegetation in fresh waters.

ADULT SIZE: 17-154 mm SL (males), 52-141 mm SL (females).

BIOLOGY: Only North American *Syngnathus* with reproducing freshwater populations. Reproduces year round in FL (Reid 1954. Bull. Mar. Sci. Gulf Carib. 4:1-94; Springer and Woodburn 1960. Prof. Pap. Fla. Board Cons. 1:1-104; Brown 1972), perhaps only in summer and fall in TX (Gunter 1945. Publ. Inst. Mar. Sci. Univ. Tex. 1:1-190). Males incubate 36-175 eggs, averaging 56 (Reid 1954; Brown 1972). Females produce 28-143 eggs (Reid 1954). Number of ovarian and brood pouch ova increases with increased body length of parents. Ova range from 0.6-1.2 mm diameter; young born at 18 mm (Brown 1972). Food consists of small crustaceans and occasionally gastropods (Reid 1954). Although Whatley (1969) proposed three year life cycle, Joseph (1957) and Brown (1972) found few survived beyond first year, with sexual maturity achieved at six months of age. A trematode was described from brood pouch (Holliman 1963. Tulane Stud. Zool. 10:83-86).

Compiler: G. H. Burgess, October 1978.

Centropomus ensiferus Poey
Swordspine snook

TYPE LOCALITY: Cuba (Poey 1860. Mem. Hist. Nat. Isla de Cuba 2:115-336).

SYSTEMATICS: Fraser (1968. Copeia. 433-60) described comparative osteology of the five Atlantic *Centropomus*, and discussed relationships within genus. Considered in phyletic line with Pacific species *C. unionensis*, *C. robalito* and *C. armatus*; most closely related to latter. Rivas (1962. Q. J. Fla. Acad. Sci. 25:53-64) keyed and discussed the four species recorded from United States waters.

Order Perciformes
Family Centropomidae



FL: Dade Co., Miami, 145 TL
(Rivas 1962).



DISTRIBUTION AND HABITAT: Estuaries and lower courses of coastal streams and canals in extreme southeast FL, West Indies, Cuba, and Atlantic drainages of Central and South America from Belize to Brazil (Rivas 1962; Rivas in McClane 1974. *McClane's New Standard Fishing Encyclopedia*: 1010-11; Greenfield 1975. Copeia: 582-83). Rarest snook in FL.

ADULT SIZE: Unknown, but probably does not exceed 255 mm TL.

BIOLOGY: Unknown. Probably eats fishes and crustaceans.

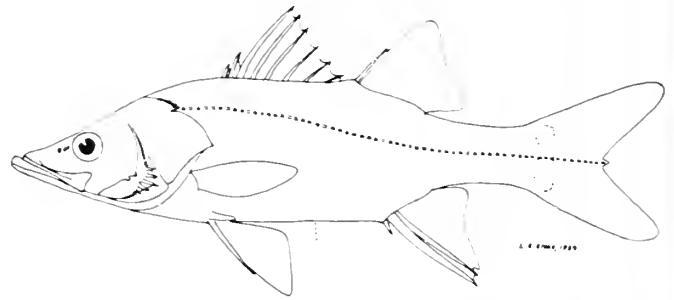
Compiler: G. H. Burgess. June 1979.

Centropomus parallelus Poey
Fat snook

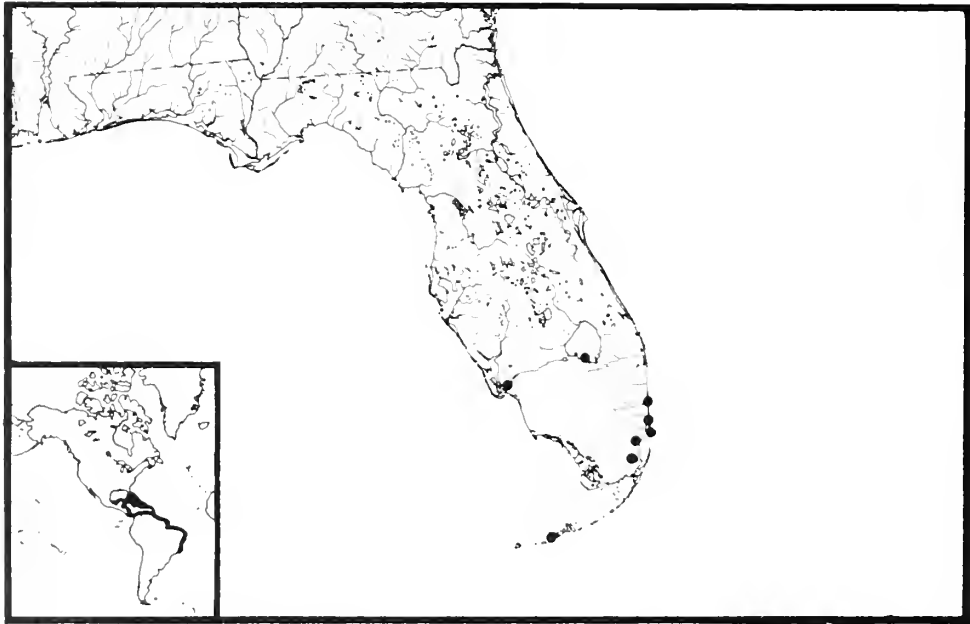
Order Perciformes
Family Centropomidae

TYPE LOCALITY: Cienfuegos, Cuba (Poey 1860. Mem. Hist. Nat. Isla de Cuba 2:115-336).

SYSTEMATICS: Fraser (1968. Copeia: 433-60) described comparative osteology of the five Atlantic *Centropomus*, and discussed relationships within genus. On phyletic line with Pacific *C. nigrescens* and Atlantic *C. undecimalis* and *C. poeyi*; most closely related to latter. Rivas (1962. Q. J. Fla. Acad. Sci. 25:53-64) keyed and discussed four species recorded from United States waters.



FL: Dade Co., Biscayne Bay.
307 mm TL (Rivas 1962).



DISTRIBUTION AND HABITAT: Occasional in bays, estuaries, canals, lower reaches of freshwater streams and coastal marine waters along southern FL peninsula, from Lake Okeechobee and Caloosahatchee River south through Keys. Also recorded from Cuba, Jamaica, West Indies, and Atlantic drainages of Mexico, Central and South America to Brazil (Rivas 1962).

ADULT SIZE: Unknown, occasionally to 500 mm TL, 712 mm TL maximum.

BIOLOGY: Little known. Gilbert and Kelso (1971. Bull. Florida State Mus. Biol. Sci. 16:1-54) observed feeding on clupeid fishes, probably also eats crustaceans.

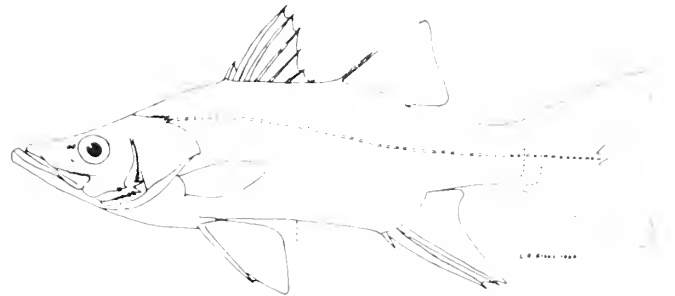
Compiler: G. H. Burgess, June 1979.

Centropomus pectinatus Poey
Tarpon snook

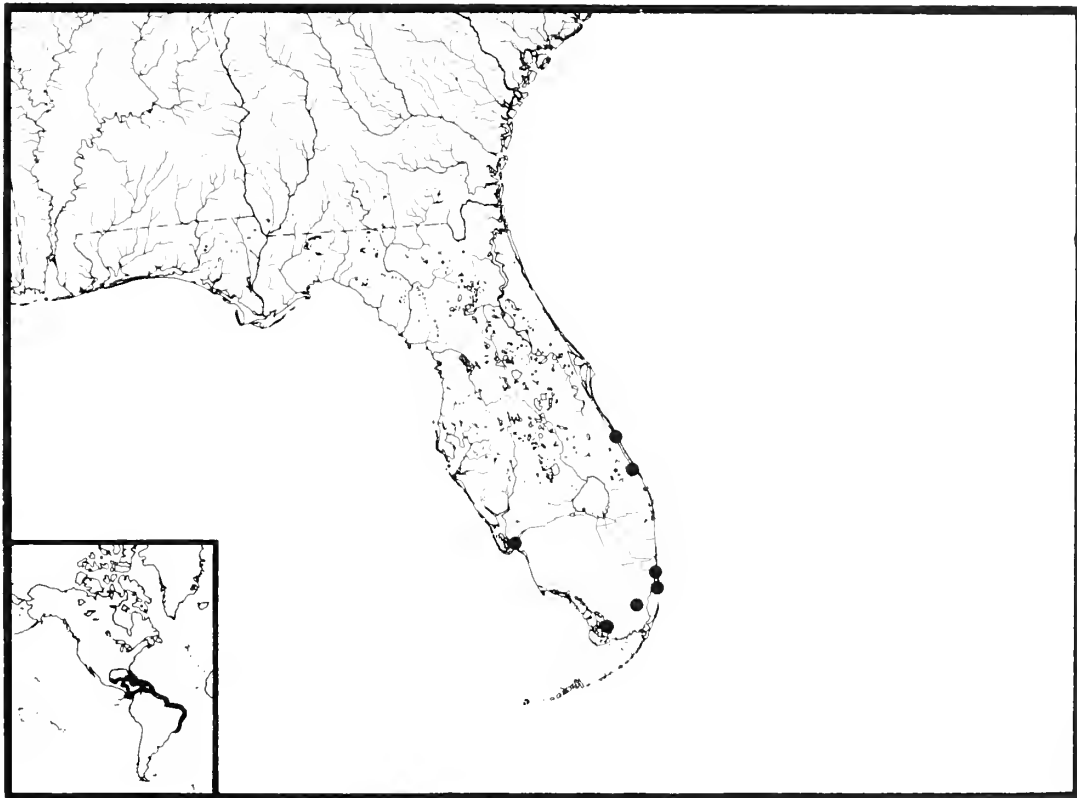
Order Perciformes
Family Centropomidae

TYPE LOCALITY: Cuba (Poey 1860. Mem. Hist. Nat. Isla de Cuba 2:115-336).

SYSTEMATICS: Fraser (1968. Copeia: 433- 60) described comparative osteology of five Atlantic *Centropomus*, and discussed relationships within genus. Represents phyletic line separate from all other *Centropomus* species. Rivas (1962. Q. J. Fla. Acad. Sci. 25:53-64) keyed and discussed four species recorded from United States waters.



FL: Dade Co., Homestead, Card Sound Canal, 306 mm TL (Rivas 1962).



DISTRIBUTION AND HABITAT: Uncommon in bays, estuaries, and lower courses of freshwater streams and canals along southern coasts of peninsular FL from lower Indian River Lagoon and Caloosahatchee River south to Card Sound. Also occurs in West Indies, Cuba, and Atlantic drainages of Central and South America south to Brazil (Rivas 1962) and on Pacific side of Isthmus of Panama (Meek and Hildebrand 1925. Field Mus. Nat. Hist. Publ. 215, Zool. Ser. 15:331-707; Chavez 1963. Ciencia, Mex. 22:141-61).

ADULT SIZE: Unknown, maximum size recorded is 400 mm TL.

BIOLOGY: Little known. Gilbert and Kelso (1971. Bull. Florida State Mus. Biol. Sci. 16:1-54) noted river shrimp, small fishes, and crabs in stomachs; the tapeworm *Gymnorhynca* appeared in coeloms of most large specimens.

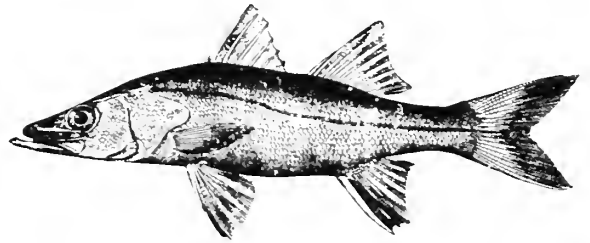
Compiler: G. H. Burgess. July 1979.

Centropomus undecimalis (Bloch)
Snook

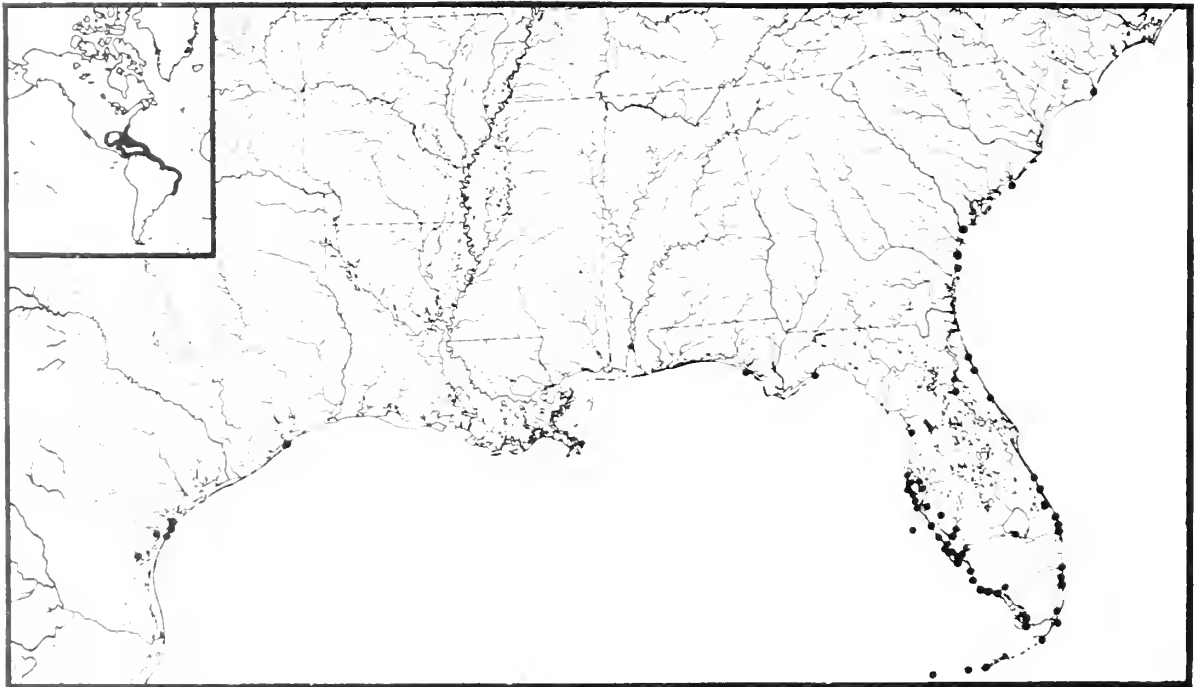
Order Perciformes
Family Centropomidae

TYPE LOCALITY: Jamaica (Bloch 1792. Naturgeschich. Ausl. Fische, Pt. 6).

SYSTEMATICS: Fraser (1968. Copeia: 433-60) described comparative osteology of five Atlantic *Centropomus*, and discussed relationships within genus. On phyletic line with Pacific *C. nigrescens* and Atlantic *C. poeyi* and *C. parallelus*; forms trans-isthmian species pair with *C. nigrescens*. Rivas (1962. Q. J. Fla. Acad. Sci. 25:53-64) keyed and discussed four species recorded from United States waters.



(Jordan and Evermann 1900)



DISTRIBUTION AND HABITAT: Common year around in bays, estuaries, canals, lower reaches of streams and coastal marine waters along southern FL peninsula from Tampa Bay, Lake Okeechobee, and Indian River Lagoon south through Keys and Tortugas. Occasional to common during warm periods north to lower Cape Fear River, NC, and possibly DE (deSylva et al. 1962. Univ. Del. Mar. Lab. Info. Ser. 5: 1-164), and along Gulf coast of FL to Destin. Texas records probably represent separate population that follows similar seasonality of distribution. Also recorded from Jamaica, Puerto Rico, Bahamas, West Indies, and Atlantic drainages of Central and South America to Rio de Janeiro, Brazil.

BIOLOGY: Reknowned game fish that supports substantial sport fishery. Marshall (1958. Fla. State Board Conserv. Tech. Ser. 22:1-39) reported on spawning season (June-November) and place (probably river mouths and passes), size at maturity (virtually all at 500 mm TL), sex ratio (approximately 1:1), length/weight relationships, parasites (nematodes), and food habits (primarily fishes, some crustaceans). Volpe (1959. Fla. State Board Conserv. Tech. Ser. 31:1-37), also working with southwest FL fishes, studied migrations (minimal) and age and growth (reaches at least seven years). Harrington and Harrington (1961. Ecology 42:646-66) and Linton and Rickards (1965. Q. J. Fla. Acad. Sci. 28:185-89) noted food habits of juveniles. Very sensitive to low temperatures and susceptible to hypothermal stress at less than 15.5°C (Marshall 1958).

Compiler: G. H. Burgess. June 1979.

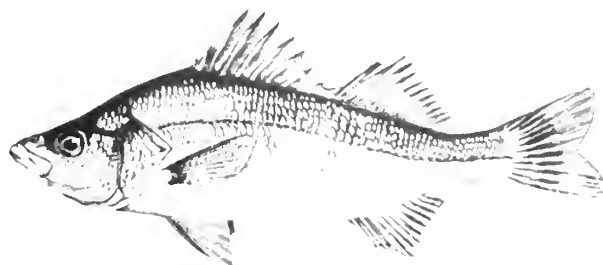
ADULT SIZE: 350-1000 mm FL, 1400 mm TL maximum.

Morone americana (Gmelin)
White perch

Order Perciformes
Family Percichthyidae

TYPE LOCALITY: New York (Gmelin in Linnaeus 1788. *Systema naturae*, Laurentii, Salvii Holmiae, 13 ed., 1:1126-516).

SYSTEMATICS: Whitehead and Wheeler (1966. Ann. Mus. Civ. Stor. Nat. Genova [1966-67] 76:23-41) showed priority of *Morone* over *Roccus*. Intraspecific variation described by Woolcott (1962. Chesapeake Sci. 3:94-113).



(N.C. Wildl. Resour. Comm.
and NCSM).



DISTRIBUTION AND HABITAT: Predominantly brackish-water species ranging from Cape Breton Island to SC, reaching peak abundance in Hudson River and Chesapeake Bay. Freshwater populations in coastal ponds and lakes throughout range, but more common in northern areas. Widespread in Lake Ontario, but not taken in Lake Erie since Larsen's (1954. Copeia: 154) initial capture of three specimens. Scott and Christie (1963. J. Fish. Res. Board Can. 20:1189-95) suggested that invasion of Lake Ontario and upper St. Lawrence River occurred as result of westward movements of Hudson River fish through Erie Barge Canal and Oswego River. Introduced in NB (Hergenrader and Bliss 1971. Trans. Am. Fish. Soc. 100:734-38). **ADULT SIZE:** 100-170 mm, 483 mm SL maximum.

BIOLOGY: Observation on age, growth, reproduction, and mortality provided by Mansueti (1961. Chesapeake Sci. 2:142-205), and St. Pierre and Davis (1972. Chesapeake Sci. 13:272-81). Eggs, larvae, and young described by Mansueti (1964. Chesapeake Sci. 5:3-45). Leach (1962. M.A. thesis, Univ. Toronto) and Reid (1972. Trans. Am. Fish. Soc. 101:608-12) reported on food habits. Spawning activities noted by Sheri and Power (1968. J. Fish. Res. Board Can. 25:2225-31) and Scott and Crossman (1973. *Freshwater Fishes of Canada*). Sheri and Power (1969. Can. Field-Nat. 83:160-61) demonstrated vertical diel movements, and Hoffman (1967. *Parasites of North American Freshwater Fishes*) listed parasites.

Compiler G. H. Burgess. September 1978.

***Morone chrysops* (Rafinesque)**
White bass

Order Perciformes
Family Percichthyidae



(N.C. Wildl. Resour. Comm.
and NCSM)

TYPE LOCALITY: "Falls of Ohio" (Ohio River at Louisville, KY) (Rafinesque 1820. West Rev. Misc. Mag. 1:361-77).

SYSTEMATICS: Formerly included in *Roccus*, which recently was synonymized with *Morone* (Whitehead and Wheeler 1966. Ann. Mus. Civ. Stor. Nat. Genova [1966-67] 76: 23-41). Electrophoretic investigation (Wright and Hasler 1967. Am. Nat. 101:401-13; Baglin 1975. Ph.D. diss., Univ. Oklahoma) revealed that distinct subpopulations may exist even within a single lake.



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Wide-ranging throughout river systems of Mississippi and Ohio valleys and Great Lakes; one Superior record (Hatch and Clark 1977. J. Minn. Acad. Sci. 43:7). Peripheral limits include the St. Lawrence River to the east, Lake Winnipeg to the north (a recent extension with presumed access through the Red River; Scott and Crossman 1973. *Freshwater Fishes of Canada*), and the Rio Grande to the west. Abundant in clear lakes and reservoirs. Becoming increasingly common in Missouri River following construction of reservoirs, which have reduced turbidity (Pflieger 1975. *The Fishes of Missouri*). Widely introduced within and outside its natural range.

BIOLOGY: A potamodromous species that homes (often in unisexual schools) to spawning sites on shoals and in streams in spring (Wright and Hasler 1967; Baglin 1975). The adhesive, mature ova range from 0.57-0.85 mm in diameter; fecundity ranges from 61,700-994,000 (Newton 1968. M. Sc. thesis, Univ. Arkansas; Baglin 1975). Fish (1935. Bull. U. S. Bur. Fish. [1932] 47:293-398) described early larvae. Growth is rapid; age and growth studies on this popular game fish are numerous (see included references in Baglin 1975). Food consists of aquatic crustaceans and insects, and fishes, principally sunfishes and minnows (Voigtlander and Wissing 1974. Trans. Am. Fish. Soc. 103:25-31). Sigler (1949. Iowa Agri. Exp. Sta. Res. Bull. 366:201-44) and Riggs (1953. Ph.D. diss., Univ. Michigan) provided life histories.

Compiler: G. H. Burgess. November 1978.

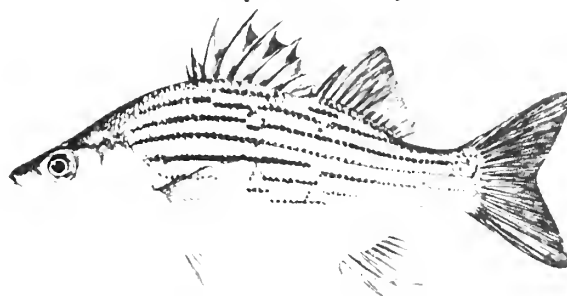
ADULT SIZE: 275-120 mm TL.

Morone mississippiensis Jordan and
Eigenmann
Yellow bass

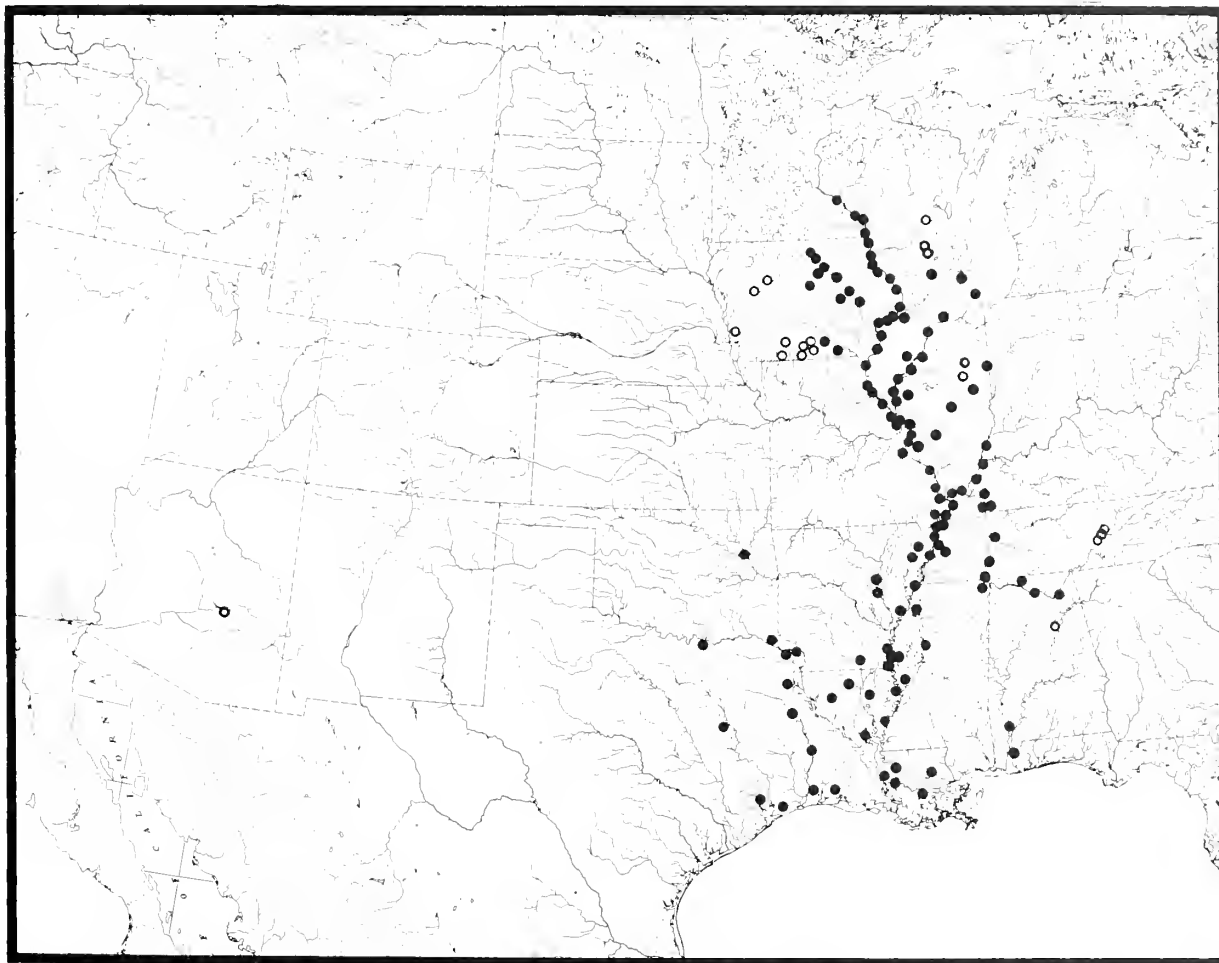
Order Perciformes
Family Percichthyidae

TYPE LOCALITY: St. Louis, MO, and New Orleans, LA (Jordan and Eigenmann 1887. Proc. Acad. Nat. Sci. Phila. 39:295-96).

SYSTEMATICS: Formerly in genus *Roccus*, synonymized with *Morone* by Whitehead and Wheeler (1966. Ann. Mus. Civ. Stor. Nat. Genova 76:23-41). Jordan and Eigenmann (1887) proposed *M. mississippiensis* as substitute name for *M. interrupta*, preoccupied in *Roccus*.



(Harlan and Speaker 1951. *Iowa Fish and Fishing*)



Open circles transplanted populations

DISTRIBUTION AND HABITAT: More strictly confined to central Mississippi Valley than *M. chrysops*. Moderately common in quiet pools and backwaters of large streams, lakes, and reservoirs from MN to LA, eastern TX, and lower Coosa and Mobile Bay drainages. Introduced less extensively than *M. chrysops*.

ADULT SIZE: 240-275 mm TL.

BIOLOGY: Little information available. Moves into tributary streams in April and May to spawn over gravelly bottoms in

waters 0.6-0.9 m deep. Eggs, smaller than those of *M. chrysops*, hatch in 4-6 days at 21°C (Burnham 1909. Trans. Am. Fish. Soc. 39:103-08; Pflieger 1975. *The Fishes of Missouri*). Schools and feeds in midwater or near surface on small crustaceans, insects, and fish (Collier 1959. Proc. Iowa Acad. Sci. 66:518-22; Welker 1963. Proc. Iowa Acad. Sci. 69:286-95). Age and growth studied by Schoffman (1958. J. Tenn. Acad. Sci. 33:101-05).

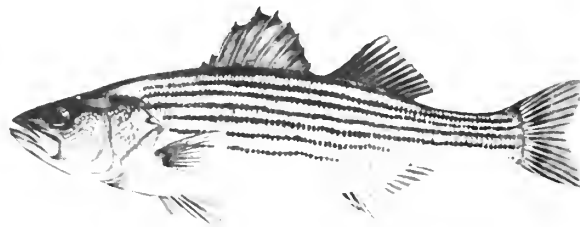
Compiler: G. H. Burgess, November 1978.

Morone saxatilis (Walbaum)
Striped bass

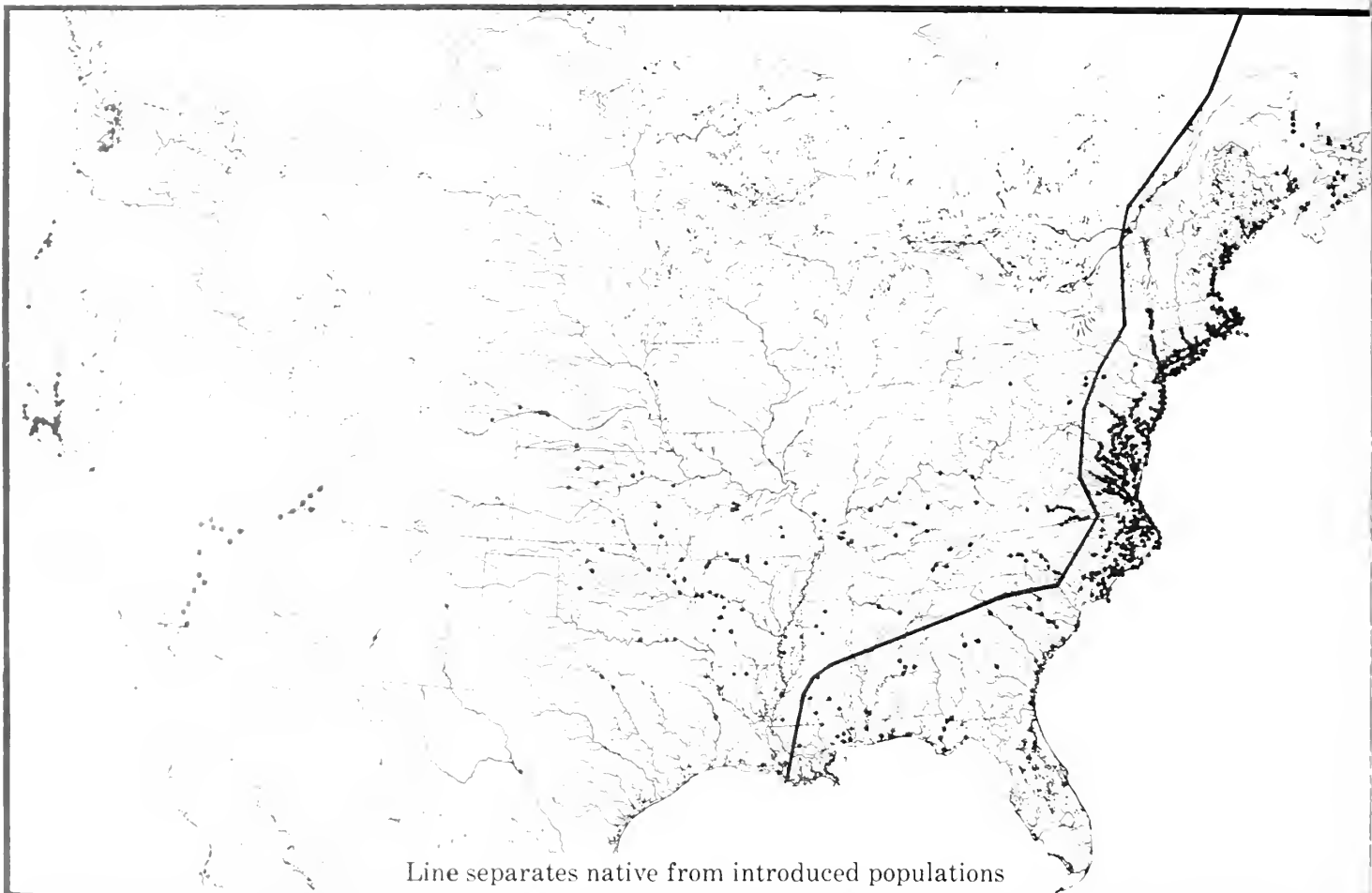
Order Perciformes
Family Percichthyidae

TYPE LOCALITY: "New York" (Walbaum in Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Appears in earlier literature as *Roccus lineatus*. Whitehead and Wheeler (1966. Ann. Mus. Civ. Stor. Nat. Genova 76:23-41) showed that *Morone* has priority over *Roccus*.



(N.C. Wildl. Resour. Comm.
and NCSM)



Line separates native from introduced populations

DISTRIBUTION AND HABITAT: A marine and estuarine coastal species that moves far upstream in rivers during spawning migrations. Native range is from St. Lawrence River, NK, south to St. Johns River, FL, and disjunctly from Suwannee River, FL, to Lake Ponchartrain, LA. Widely introduced into lakes and impoundments throughout United States, sometimes as artificial hybrid with *M. chrysops*. Introduced on Pacific coast in the San Francisco estuary in 1879 and 1882; since spread to Vancouver Island, BC, and northern Baja California, Mexico.

ADULT SIZE: 150-2000 mm TL.

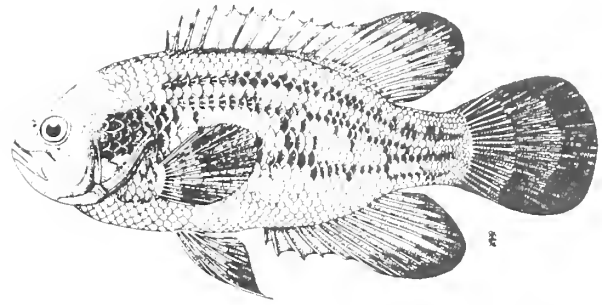
BIOLOGY: Supports extremely important sport and commercial fisheries, so much bio-

logical information available. Pearson (1938. U.S. Bur. Fish. Bull. 28:825-51), Raney (1952. Bull. Bingham Oceanogr. Coll. 14:5-97), Bigelow and Schroeder (1953. U.S. Fish Wildl. Serv. Fish. Bull. 74:1-577), Liem and Scott (1966. Fish. Res. Board Can. Bull. 155: 1-485), and Scott and Crossman (1973. *Freshwater Fishes of Canada*) provided biological summaries and listed important references. Spawning occurs in spring in upstream portions of rivers above tidal influence. Fecundity ranges from 14,000-3,220,000 eggs (Raney 1952). Pearson (1938) described early larvae. Larvae feed on zooplankton, young primarily consume invertebrates, and adults are predatory on fish and larger crustaceans. Raney (1952) listed parasites.

Compiler: G. H. Burgess. November 1978.

***Acantharchus pomotis* (Baird)**
Mud sunfish

Order Perciformes
Family Centrarchidae



MD: Queen Annes Co., Tuckahoe River drainage, 95 mm SL (NCSM).



Map modified from Cashner 1974

DISTRIBUTION AND HABITAT: Widely distributed throughout Atlantic Coastal Plain from NY to northern FL and along FL panhandle as far west as St. Marks River. Appears nowhere to be especially common. Primarily inhabitant of darkly stained, sluggish, weedy lowland streams and lakes, with mud or silt substrates (Bailey 1938). Mansueti and Elser (1953, Copeia :117-18) discussed preference in MD lakes.

ADULT SIZE: 111-170 mm SL.

BIOLOGY: Abbott (1884, *A Naturalist's Rambles About Home*) and Breder (1936, *Zoologica* 21:1-48) recorded nocturnal and secretive habits. Breder (1936) summarized breeding habits. Mansueti and Elser (1953) presented growth data. Carlander (1977, *Handbook of Freshwater Fishery Biology* Vol. 2) provided summary of length, weight, and age data.

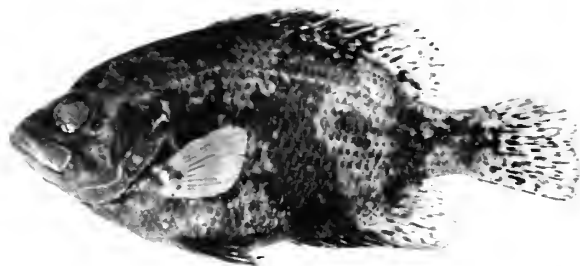
Compiler: R. C. Cashner, November 1978.

Ambloplites ariommus Viosca
Shadow bass

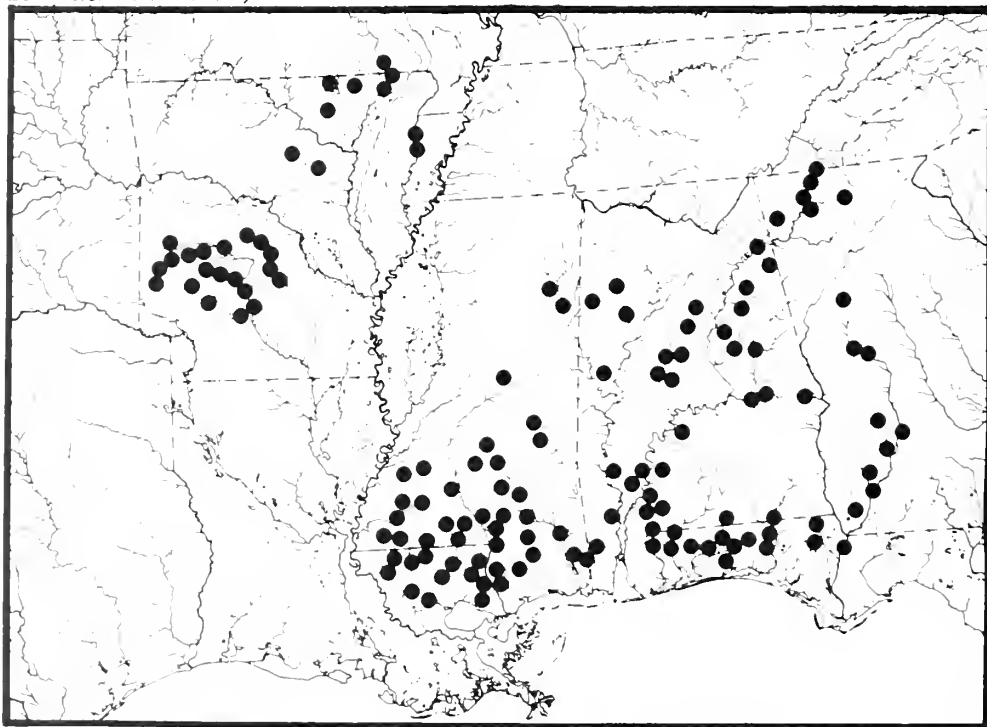
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Little Bougue Falia Creek, Tchefuncte River drainage, 4.8 km n of Covington, St. Tammany Par., LA (Viosca 1936. Copeia: 37-45).

SYSTEMATICS: Regarded as subspecies of *A. rupestris* since late 1940s. Bailey and Hubbs (1949. Occas. Pap. Mus. Zool. Univ. Mich. 516:1-40) and Smith-Vaniz (1968. *Freshwater Fishes of Alabama*) reported intermediates between *A. ariommus* and *A. rupestris* from MO and AR lowlands and northern AL, respectively. Based on characters of squamation, color pattern, and morphometry, most of above specimens could be referred to *A. ariommus*. Sympatric but not syntopic with *A. rupestris* in Alabama River system. Problematic areas, in Neosho River system and southeastern MO, difficult to resolve, perhaps due to extensive introduction of mixed stocks of *A. rupestris* (Cashner and Suttkus 1977. Am. Midl. Nat. 98:147-61; 1978. Southwest. Nat. 23:463-72).



GA: Lee Co., Flint River, 153 mm SL (R. C. Cashner).



Modified from Cashner 1974. Ph.D. diss., Tulane Univ.

DISTRIBUTION AND HABITAT: Widely distributed in Gulf slope drainages, above and below Fall Line, from Apalachicola west to Lake Pontchartrain drainages in eastern LA, and in east and west flowing tributaries of lower Mississippi Valley as far north as southeastern MO. Inhabits streams with permanent flow, low turbidity, silt-free mud, or sand and gravel substrates throughout Gulf slope. In upland areas substrates primarily gravel and rubble.

ADULT SIZE: Smallest member of genus, maximum size rarely exceeding 180 mm SL.

BIOLOGY: Most of the scant information available on age, growth, and food habits reported by Viosca (1936). Based on collections and observations in LA and MS, spawning season begins late April and lasts until Mid-August.

Compiler: R. C. Cashner. March 1979.

Ambloplites cavifrons Cope
Roanoke bass

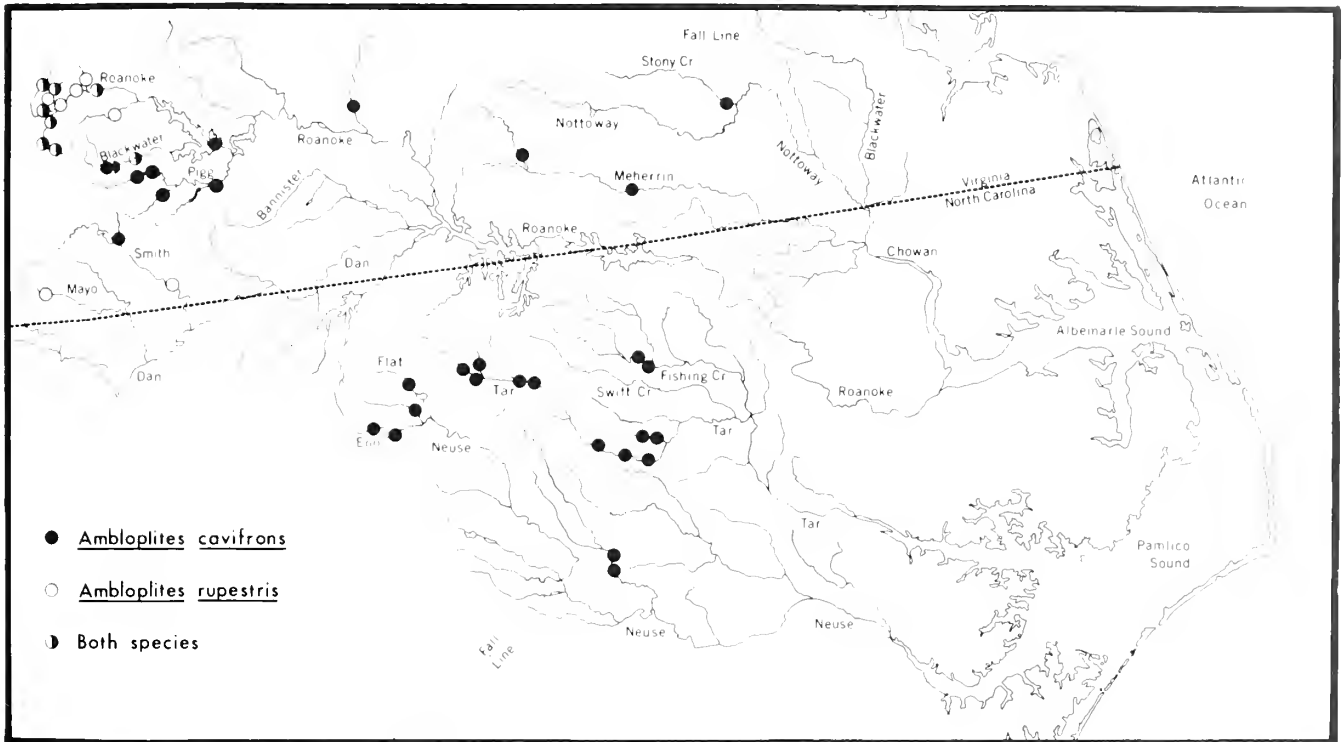
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Headwaters of Roanoke River, Montgomery Co., VA (Cope 1868. J. Acad. Nat. Sci. Phila. [Ser. 2] 6:207-47).

SYSTEMATICS: At various times since late 1800's ranked as species, or subspecies of *A. rupestris*. Based on adequate materials only recently available, now considered a full species, although hybridizes with *A. rupestris* in one area but not in others (Cashner 1974. Ph.D. diss., Tulane Univ.; Cashner and Jenkins ms.).



VA: Franklin Co., Pigg River, male, 195 mm SL (R. C. Cashner).



Map modified from Cashner 1974 and Smith 1971

DISTRIBUTION AND HABITAT: Endemic to Roanoke, Chowan, Tar, and Neuse River drainages, VA and NC. Occupies Ridge and Valley, Piedmont and upper Coastal Plain physiographic provinces. Typically in medium to large, clear to often moderately turbid, warm streams with rock, gravel, sand and silt substrates. Generally uncommon to rare; most common in clearer, firmer bottomed streams. Rarely found naturally in impoundments (Smith Mountain Reservoir, VA). Introductions to ponds and reservoirs in NC mostly unsuccessful (W. B. Smith, pers. comm.). Nearly extirpated in upper Roanoke drainage due to introduction of *A. rupestris* and habitat alteration. Apparently has declined widely elsewhere, at least in VA.

ADULT SIZE: Confirmed records of over 300 mm SL, larger specimens reported.

BIOLOGY: Fingerling and yearling hatchery stock feed almost exclusively on aquatic insects. Wild adults consume crayfish and fish almost exclusively. Maximum longevity in wild ca. seven years. Sexual maturity age-size dependent, reached upon attainment of at least two years age and ca. 100 g or more. Fecundity 3500-9600 in wild specimens. Spawns between mid-May and mid-June. Nests in hatchery ponds constructed and guarded by males in shallows on gravel; sand and muck substrate avoided (Smith 1971. The Biology of the Roanoke bass. N. C. Wildl. Resour. Comm., Raleigh: 1-31; 1972. Proc. 25th Ann. Conf. Southeast. Assoc. Game Fish Comm.). Largest average size of all *Ambloplites*.

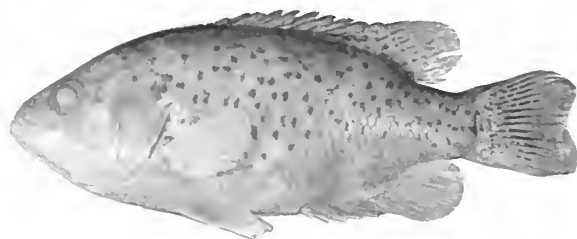
Compilers: R. C. Cashner and R. E. Jenkins. December 1978.

Ambloplites constellatus Cashner
and Suttkus
Ozark rockbass

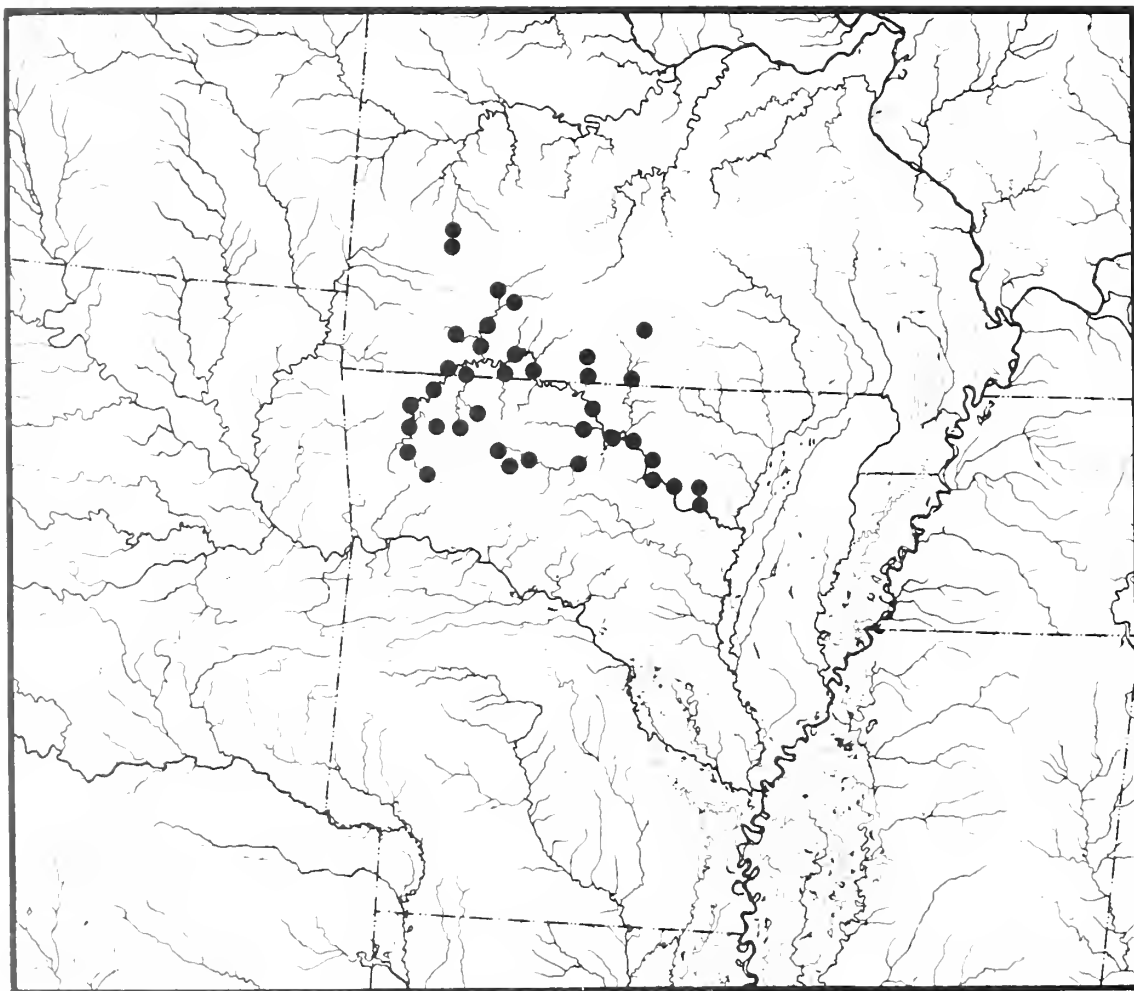
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Buffalo River at mouth of Rush Creek, 3.2 km ese Rush, Marion Co., AR (Cashner and Suttkus 1977. Am. Midl. Nat. 98:147-61).

SYSTEMATICS: Closely related to *A. rupestris*, but differs markedly in color pattern and has finer squamation than *A. rupestris* or any *Ambloplites* populations in adjacent drainages. Also characterized by having more slender, elongate body form and less variation in color pattern than congeners.



AR: Izard Co., White River at Sylamosa, female, 162 mm SL (R.C. Cashner).



Map from Cashner and Suttkus 1977

DISTRIBUTION AND HABITAT: Restricted to Ozark Upland section of White River system in MO and AR, and tributaries to Osage River in MO. Widely introduced into other drainages in MO and AR (Morris and Collins, pers. comm.), but no evidence of hybridization found between *A. constellatus* and *A. rupestris* or between *A. constellatus* and other adjacent populations of *Ambloplites*. Habitat very similar to that of upland populations of *A. rupestris*, mainly small to moderate-sized streams, with permanently flowing water, high dissolved oxygen,

abundant aquatic vegetation, low turbidity, and silt-free substrates. One of the most common centrarchids in Buffalo River and unimpounded sections of upper White River.

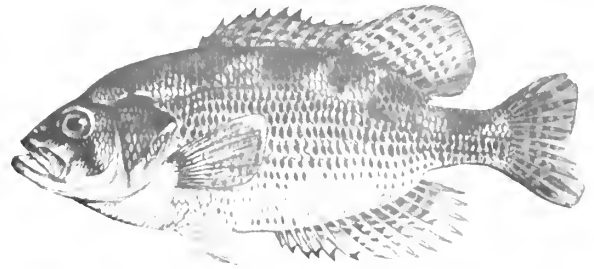
ADULT SIZE: 103-162 mm SL.

BIOLOGY: No information available. Assumed to be similar in gross details of reproduction outlined for *A. rupestris* by Breder (1936. Zoologica 21:1-48).

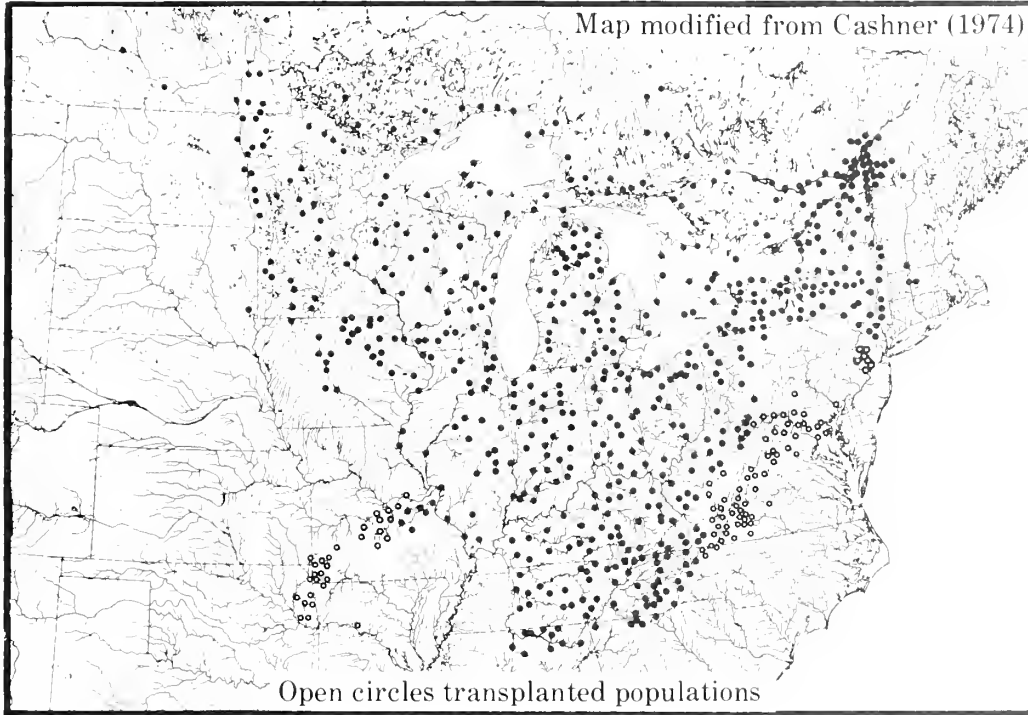
Compiler: R. C. Cashner. October 1978.

Ambloplites rupestris (Rafinesque)
Rock bass

Order Perciformes
Family Centrarchidae



(N.C. Wildl. Resour. Comm.
and NCSM)



showed these to be valid species. Phylogenetic relationships have been presented, based on spine number (Schlaikjer 1937. *Bull. Am. Mus. Nat. Hist.* 74:1-23), acoustico-lateralis system (Branson and Moore 1962. *Copeia*:1-108), and hybridization (Hester 1970. *Trans. Am. Fish. Soc.*, 99:100-04). Bailey (1938) reviewed systematics. Roberts (1964. *J. Morphol.* 115:401-09) reported on chromosome number and Cashner (1974) on geographic variation.

DISTRIBUTION AND HABITAT: Most widely distributed member of genus. Native to southern MA and Red River drainage of ND, through southern ON and Great Lakes, and St. Lawrence River to QU and Lake Champlain; west of Appalachian divide, south to Tennessee River drainage and possibly Upper Mobile Bay drainage in AL, and in eastern and western tributaries to Middle and Upper Mississippi Valley. Widely introduced and common in Atlantic slope drainages (Jenkins et al. in Holt [ed.] 1972. *Va. Polytech. Inst. State Univ. Res. Div. Monogr.* 4:43-117), New (upper Kanawha) River drainage, and established in several states west of native range (Cashner and

Suttkus 1978. *Southwest. Nat.* 23:463-72). Pflieger (1975. *The Fishes of Missouri*) suggested Osage and Gasconade populations may be introduced. Western United States introductions not mapped. Prefers small, cool, weedy lakes or littoral regions of larger lakes, and streams with typically rocky, always silt-free substrates, permanent flow, low turbidity and extensive cover. Trautman (1957. *The Fishes of Ohio*) and Smith (1979. *The Fishes of Illinois*) reported decline in waters with siltation. Hallam (1959. *J. Fish. Res.* 16:147-73) discussed environmental conditions and faunal associations.

ADULT SIZE: 89-219 mm SL.

BIOLOGY: Abundant age and growth and some fecundity data given in Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2). Breder (1936. *Zoologica* 21:1-48) recorded details of spawning and references on nest construction. Food habits reported in Carlander (1977) and Scott and Crossman (1973. *Freshwater Fishes of Canada*).

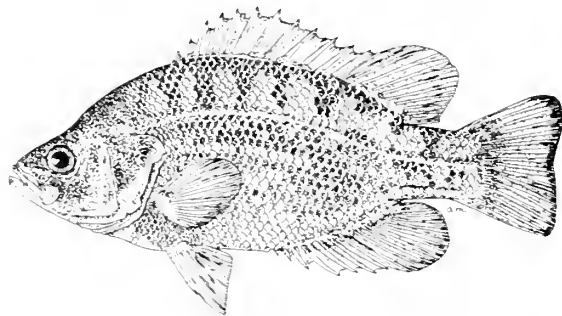
Compiler: R. C. Cashner. March 1979.

Archoplites interruptus (Girard)
Sacramento perch

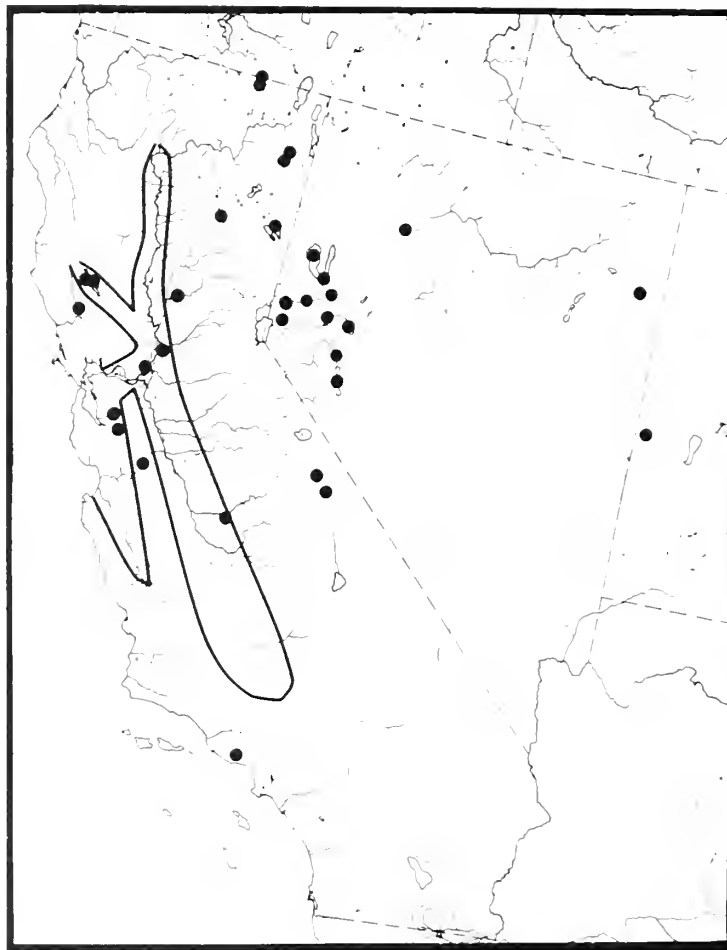
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Sacramento River, CA
(Girard 1854. Proc. Acad. Nat. Sci. Phila.
7:129-40).

SYSTEMATICS: Most "primitive" living
member of the Centrarchidae. Monotypic, al-
though Plio-Pleistocene fossils of the genus
have been found in ID and WA (Miller and
Smith 1967. Occas. Pap. Mus. Zool. Univ.
Mich. 654:1-24).



CA: Yolo Co., Yolo by-pass, 12
cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Originally
abundant in sloughs and lakes of Sacramento-
San Joaquin drainage (area outlined on map),
but now rare or absent in such habitats.
Widely introduced into alkaline lakes and re-
servoirs of CA, NV (including Pyramid
Lake), UT, CO, NB, ND, and SD. Most
known sites in CA are introduced popula-
tions in reservoirs. Numerous farm pond
populations (Aceituno and Nicola 1976.
Calif. Fish Game 62:246-54) are not shown
on map, nor are most localities outside CA and
NV.

ADULT SIZE: 200-400 mm SL, 610 mm SL
maximum.

BIOLOGY: Juveniles feed largely on chi-
ronomid midge larvae, large adults on fish.
Not as aggressive as other centrarchids,
which may account for decline when sun-
fishes, *Lepomis*, and crappies, *Pomoxis*, are
introduced into their habitats (Moyle 1976.
Inland Fishes of California; Aceituno and
Vanicek 1976. Calif. Fish Game 62:5-20).

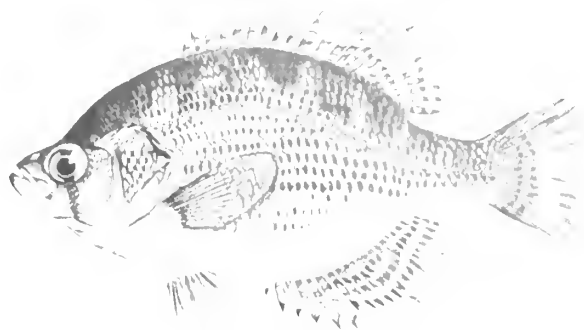
Compiler: P. B. Moyle. July 1978.

Centrarchus macropterus (Lacepede)
Flier

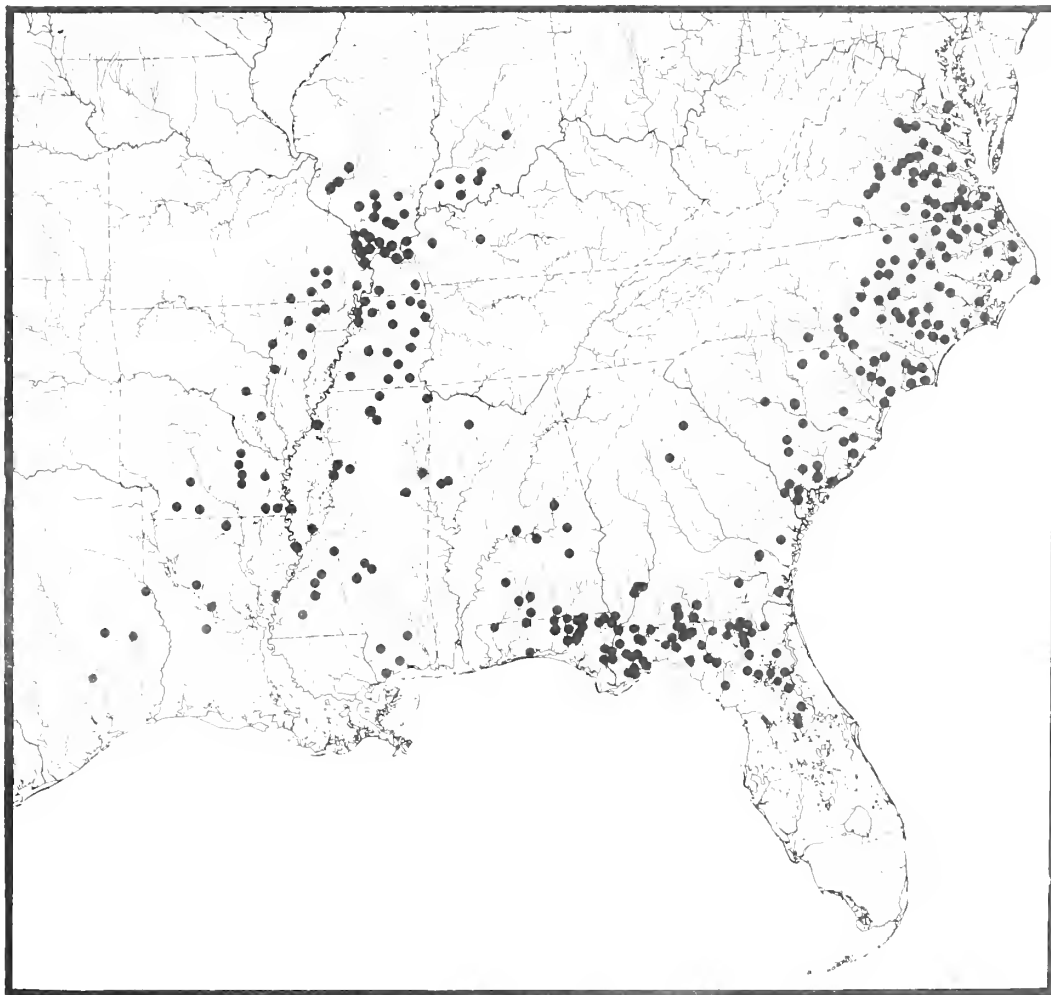
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Charleston, SC (Lacepede 1802. *Histoire Naturelle des Poissons* 3:1-16).

SYSTEMATICS: Subfamily Centrarchinae, tribe Centrarchini. Monotypic genus. Bailey (1938, Ph.D. diss., Univ. Michigan), Branson and Moore (1962, *Copeia*: 1-108) and Avise et al. (1977, *Copeia*: 250-58) studied relationships to other centrarchid genera, using various characters. *Pomoxis* seems most closely related genus in tribe Centrarchini (Avise et al. 1977).



(N.C. Wildl. Resour. Comm.
and NCSM)



DISTRIBUTION AND HABITAT: Eastern VA south to north-central FL and throughout much of Gulf coastal plain (to eastern TX) and Mississippi Valley, north to southern IL. Original status of southern MD population uncertain but may be introduced. Prefers sluggish lowland habitats with clear, heavily vegetated waters.

ADULT SIZE: 70-190 TL.

BIOLOGY: Carlander (1977, *Handbook of Freshwater Fishery Biology* Vol. 2) provided comparative length, weight, and age

data. Breeding usually occurs March to May (17°C), but reported as early as February. Lawrence (1957, *Data for Handb. Biol. Data*: 1-29) discussed colonial nesting, guarding of nest and fry, and winter schooling. Information on general life history and ecology of MO populations available in Conley (1966, M.A. thesis, Univ. Missouri) summarized in Pflieger (1975, *The Fishes of Missouri*).

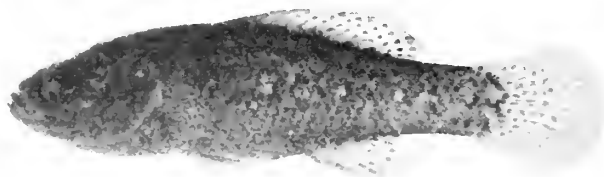
Compilers: D. S. Lee and C. R. Gilbert.
September 1979.

Elassoma evergladei Jordan
Everglades pygmy sunfish

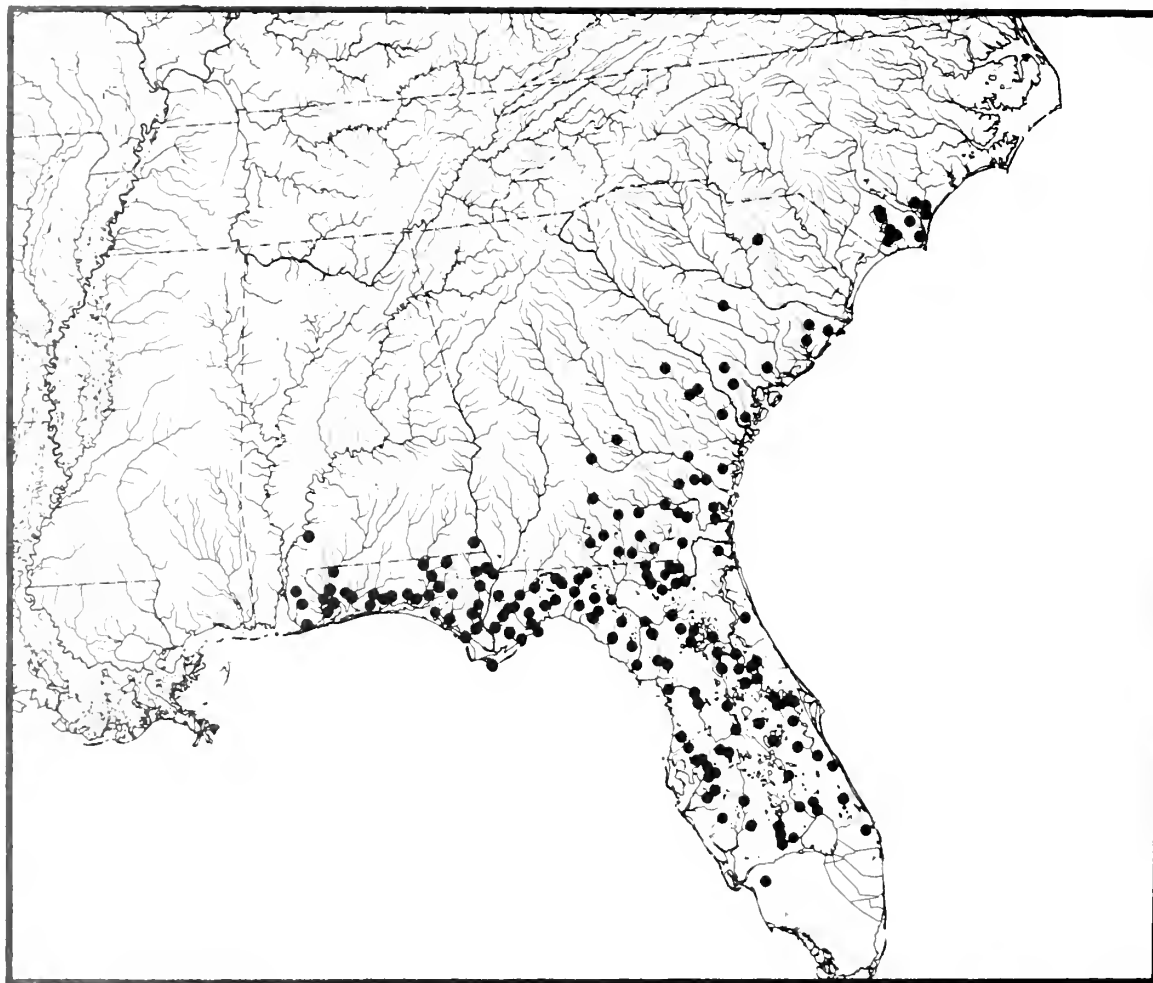
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Lake Jessup, near Sanford, Seminole Co., FL and Indian River, near Titusville, Brevard Co., FL (Jordan 1884. Proc. U.S. Natl. Mus. 7:322-24).

SYSTEMATICS: Closely related to *E. okefenokee*, to which Avise et al. (1977. Copeia: 250-58) noted genetic similarity.



FL: Columbia Co., Osceola National Forest, female, 29 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Below Fall Line in coastal streams from Cape Fear River, NC, south into southern FL, and west to Mobile Bay basin, AL. Prefers quiet, well-vegetated waters, where may be abundant.

ADULT SIZE: 18-28 mm SL.

BIOLOGY: Mettee (1974. Ph.D. diss., Univ. Alabama) studied reproductive behavior, embryology, and larval development. Eggs laid on aquatic vegetation. Incubation time (at 25.5°C) 65 hours. Lays 25 to 30 eggs. Miller (1964. Behavior 22:88-151) reported on various types of behavior: maintenance, non-social, social, and larval. Dominant food items in some NC specimens were copepods and cladocerans.

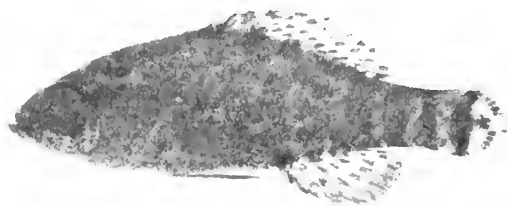
Compilers: J. E. Böhlke and F. C. Rohde. June 1979.

Elassoma okefenokee Böhlke
Okefenokee pygmy sunfish

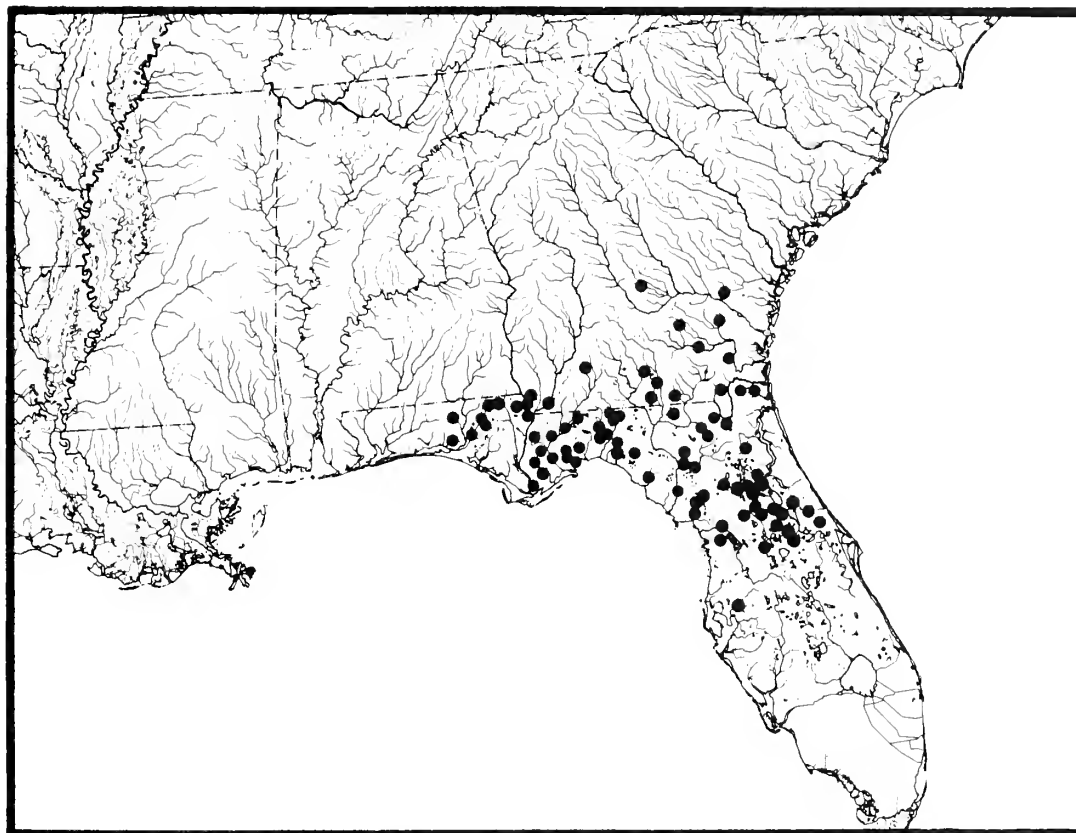
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Kettle Creek, tributary of Satilla River, near Waycross, GA (Böhlke 1956. Not. Nat. 294:1-11).

SYSTEMATICS: Closely related to *E. evergladei*, to which Avise et al. (1975. Copeia: 250-58) found genetic similarity.



FL: Madison Co., Aucilla River system, male, 21 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Presently known from Altamaha drainage in southern GA, south to Hillsborough River drainage, FL, and west in FL to Choctawhatchee drainage. Questionable record from Lake Okeechobee not shown on map. Prefers quiet, well-vegetated waters where may be abundant.

ADULT SIZE: 18-28 mm SL.

BIOLOGY: Mettee (1974. Ph.D. diss., Univ. Alabama) reported on reproductive behavior, embryology, and larval development. Eggs laid on aquatic vegetation. Incubation time 82 hours at 23°C. Produces from 20 to 25 eggs.

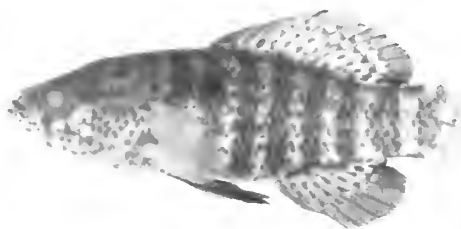
Compiler: J. E. Böhlke and F. C. Rohde.
June 1979.

Elassoma zonatum Jordan
Banded pygmy sunfish

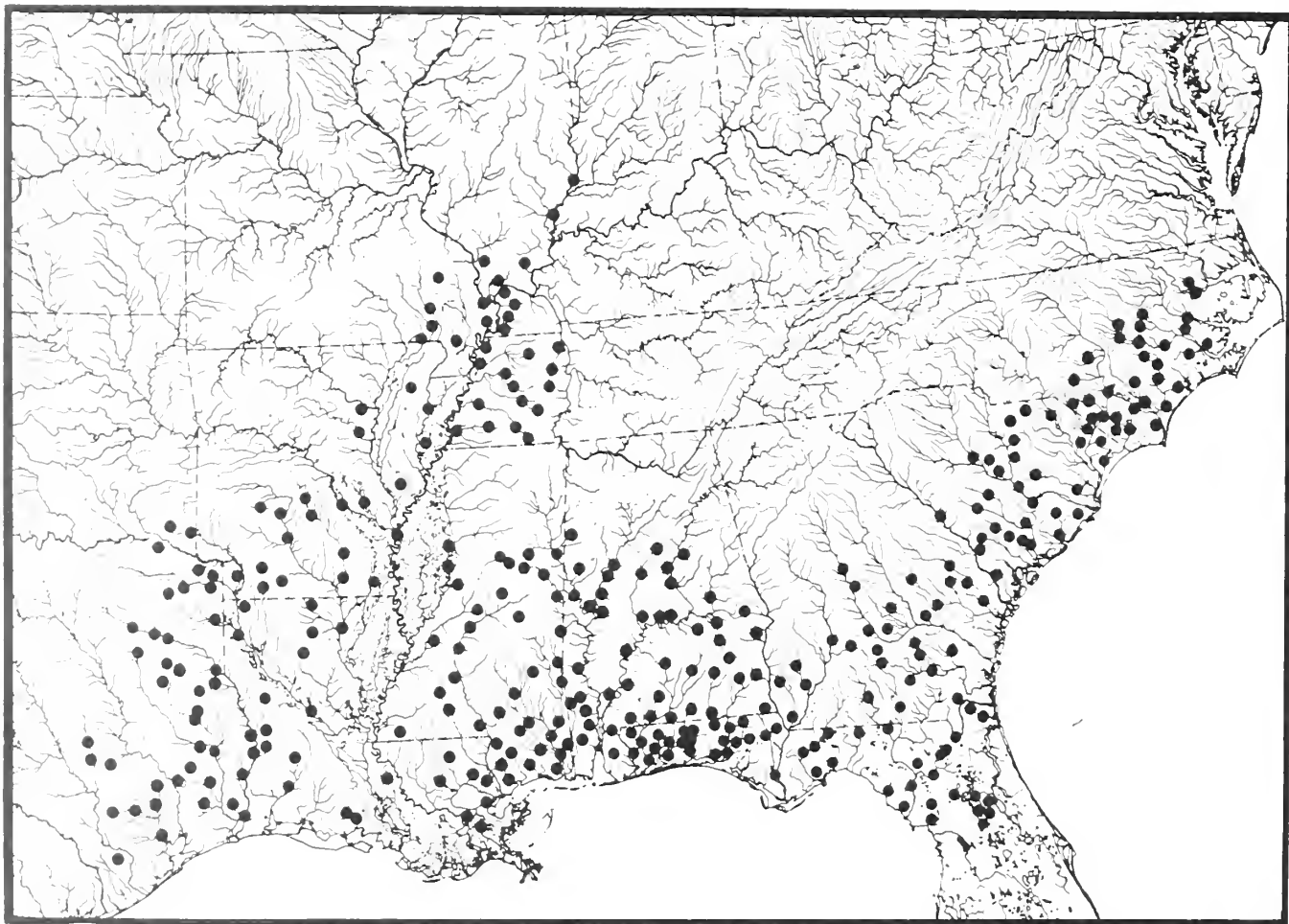
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Little Red River, White Co., AR, and Rio Brazos, TX (Jordan 1877. U.S. Natl. Mus. Bull. 10:1-68).

SYSTEMATICS: Detailed study needed. Differences exist between Atlantic slope and western populations which may prove systematically distinct. Closely related, undescribed *Elassoma* in NC and SC.



AL: Autauga Co., Alabama River system, male, 26 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Widespread throughout Coastal Plain from NC south to central peninsular FL on Atlantic slope, to TX on Gulf slope, and in Mississippi Valley as far north as IL. Common in Coastal Plain but rarely encountered above Fall Line. Prefers clear quiet waters with thick growths of submerged vegetation.

ADULT SIZE: 25-45 mm TL.

BIOLOGY: Barney and Anson (1920. Ecology 1:241-56) studied breeding habits, embryology, larval development, growth, food, and predators in northern LA. Spawns mid-March to early May. Average-size female (25 mm) lays about 300 eggs over several days in lots of 40 to 60. Incubation time (18.5°C) about seven days. Maximum life span three years. Small crustaceans principal food with larvae and pupae of midges next in importance. Mettee (1974. Ph.D. diss., Univ. Alabama) reported on reproductive behavior, embryology, and larval development in AL.

Compilers: J. E. Böhlke and F. C. Rohde. June 1979.

Enneacanthus chaetodon (Baird)
Blackbanded sunfish

Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Cedar Swamp, Cape May Co., NJ (Baird 1854. Ninth Smithson. Rep.: 317-52).

SYSTEMATICS: One of three *Enneacanthus* species. Previously placed in the monospecific genus *Mesogonistius*. Bailey (1941. Occas. Pap. Mus. Zool. Univ. Mich. 454:1-7) described south GA and FL populations as a distinct subspecies, but Sweeney (1972. Ph.D. diss., Boston Univ.) found differences insufficient for subspecific recognition.



DE: Sussex Co., Raccoon Pond,
63 mm TL (NCSM).



DISTRIBUTION AND HABITAT: Primarily Atlantic Coastal Plain from NJ to central FL, but also in several Gulf slope drainages (Aucilla and Econfinia rivers). Distribution summarized by Sweeney (1972), Jenkins et al. (1975. Va. J. Sci. 26:128-34) and Burgess et al. (1977. Fla. Sci. 40:33-41). Very sporadic distribution; absent from many areas within range having apparently favorable habitat. Largely restricted to quiet, shallow, heavily vegetated, nonturbid, darkly stained, acidic waters of streams, margins of rivers, ponds, and lakes.

ADULT SIZE: 29-66 mm SL.

BIOLOGY: Schwartz (1961. Chesapeake Sci. 2:82-88) provided information on food habits, age, growth, and morphology based on 90 specimens collected in MD. March spawning observed in NC (Smith 1907. *Fishes of North Carolina*). Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) summarized available information on weight, size, and SL at each annulus. Smith (1907) discussed observations of captive specimens.

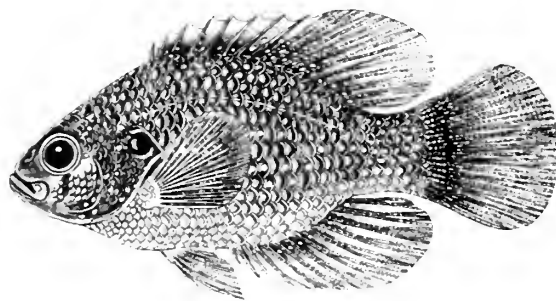
Compiler: D. S. Lee. May 1978.

Enneacanthus gloriosus (Holbrook)
Bluespotted sunfish

Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Cooper River, SC (Holbrook 1855. J. Acad. Nat. Sci. Phila. 3:47-58).

SYSTEMATICS: One of three *Enneacanthus*, all of which are essentially confined to Atlantic slope. Sweeney (1972. Ph.D. diss., Boston Univ.) reviewed osteology and other aspects of systematics. Although obviously specifically distinct from the closely related *E. obesus*, with which it occurs sympatrically in many places, confusing intermediacy of some populations suggests possibility of hybridization.



MD: Anne Arundel Co., 49.5 mm SL (NCSM).



Open circle transplanted population

DISTRIBUTION AND HABITAT: Coastal lowlands from extreme southern NY to extreme western FL. More common, uniformly distributed and less ecologically specialized than other two *Enneacanthus* species, particularly *E. chaetodon*. Common in heavily vegetated, sluggish waters. Recently established in Lake Ontario drainage of NY (Werner 1972. Copeia:878-79).

BIOLOGY: Breder and Redmond (1929. Zoologica 9:379-401) and Breder (1936. Zoologica 21:1-48) discussed spawning season, incubation and food habits. Flemer and Woolcott (1966. Chesapeake Sci. 7:75-89) gave additional information on feeding. Raney (1965. The Conservationist. N.Y. State Cons. Dept. 19:21-29, 35) gave information on spawning behavior, breeding colors, food, and size of spawning adults. Werner (1972) and Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) provided information on age classes.

Compilers: D. S. Lee and C. R. Gilbert.
May 1978.

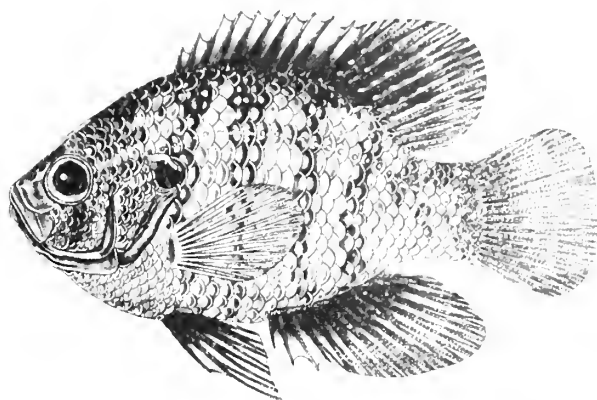
ADULT SIZE: 61-78 mm SL.

***Enneacanthus obesus* (Girard)**
Banded sunfish

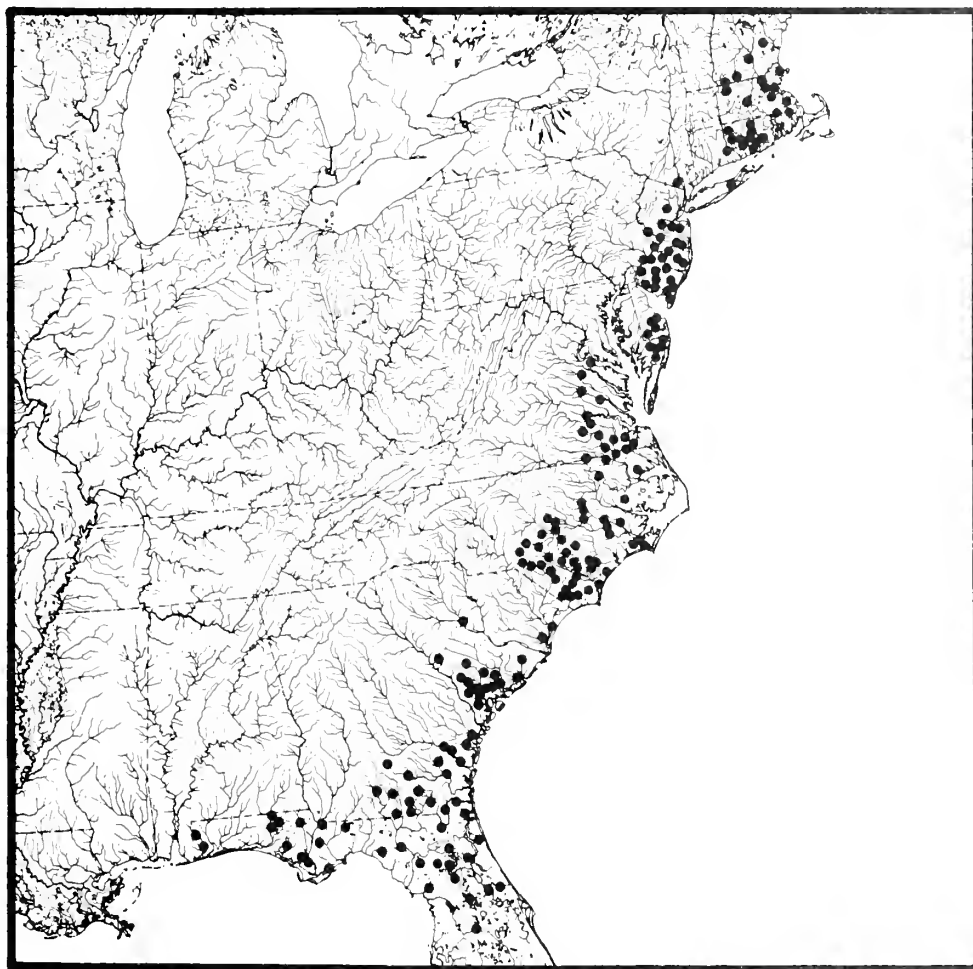
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Fresh waters about Hingham, and in a branch of the Charles River, at Holliston, MA (Girard 1854. Proc. Boston Soc. Nat. Hist. 5:40-43).

SYSTEMATICS: One of three species of *Enneacanthus*, all of which primarily occur along the Atlantic slope. *E. obesus* and *E. gloriosus*, though distinct species, have often been confused in the past (Palmer and Wright 1920. Proc. Iowa Acad. Sci. 27:353-77). Although not reported in literature to hybridize with *E. gloriosus*, intermediate appearance of individuals in some populations suggests that this may occur. Sweeney (1972. Ph.D. diss., Boston Univ.) reviewed systematics and osteology of the genus.



MD: Worchester Co., St.
Martin's River, 55 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Sluggish, acidic, heavily vegetated waters of Atlantic coastal region, from southern NH to the Perdido drainage in extreme western FL. This species and *E. chaetodon* are morphologically and behaviorally adapted to nutrient poor, dystrophic habitats.

ADULT SIZE: 51-70 mm SL.

BIOLOGY: Food habits and reproduction not thoroughly studied but apparently similar to *E. gloriosus*. Harrington (1956. J. Exp. Zool. 131:203-24) studied effect of temperature and photoperiod on development of gonad size and sexual colors.

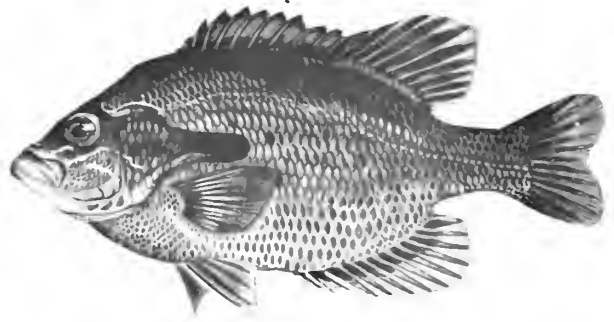
Compilers: D. S. Lee and C. R. Gilbert.
May 1978.

Lepomis auritus (Linnaeus)
Redbreast sunfish

Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Philadelphia, PA (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Subfamily Lepominae, tribe Lepomini. Bailey (1938. Ph.D. diss., Univ. Michigan) reviewed systematics. Avise and Smith (1974. *Am. Nat.* 108: 458-72), on basis of electrophoretic properties, determined closest relatives to be *L. punctatus* and *L. gibbosus*, although Branson and Moore (1962. *Copeia*: 1-108) who studied acoustico-lateralis system, felt closest relationships were with *L. megalotis* and *L. marginatus*.



(N.C. Wildl. Resour. Comm. and NCSM).



Former Distribution



Present Distribution

DISTRIBUTION AND HABITAT: On Atlantic slope, believed native north to southern NK. Throughout Atlantic slope from NK south to central FL, west to Apalachicola River. Probably native only as far west as Choctawhatchee drainage, western FL. Mobile Bay populations probably introduced. Transplanted into several areas outside original range and into lakes in northern Italy. Tends to be more of a river species than most other *Lepomis*. Generally common.

ADULT SIZE: ca. 60-155 mm TL.

BIOLOGY: One of few centrarchids native east of Appalachians and only one not producing sound during courtship (Gerald 1971. *Evolution* 25:75-87). Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) summarized literature on weight, length, age, growth, and food habits. Scott and Crossman (1973. *Freshwater Fishes of Canada*) provided some information on ecology in NK.

Compiler: D. S. Lee. February 1978.

Lepomis cyanellus Rafinesque
Green sunfish

Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Ohio River (Rafinesque 1819. J. Phys. Chim., Hist. Nat., Arts 88: 417-29).

SYSTEMATICS: Possibly most primitive species of typical *Lepomis*, and similar to *L. gulosus* (Branson and Moore 1962. Copeia:1-108; Smith and Lundburg 1972. Bull. Am. Mus. Nat. Hist. 148:40-54). Known to hybridize with at least five other *Lepomis*.



(N.C. Wildl. Resour. Comm.
and NCSM)



Former Distribution



Present Distribution

See map on next page

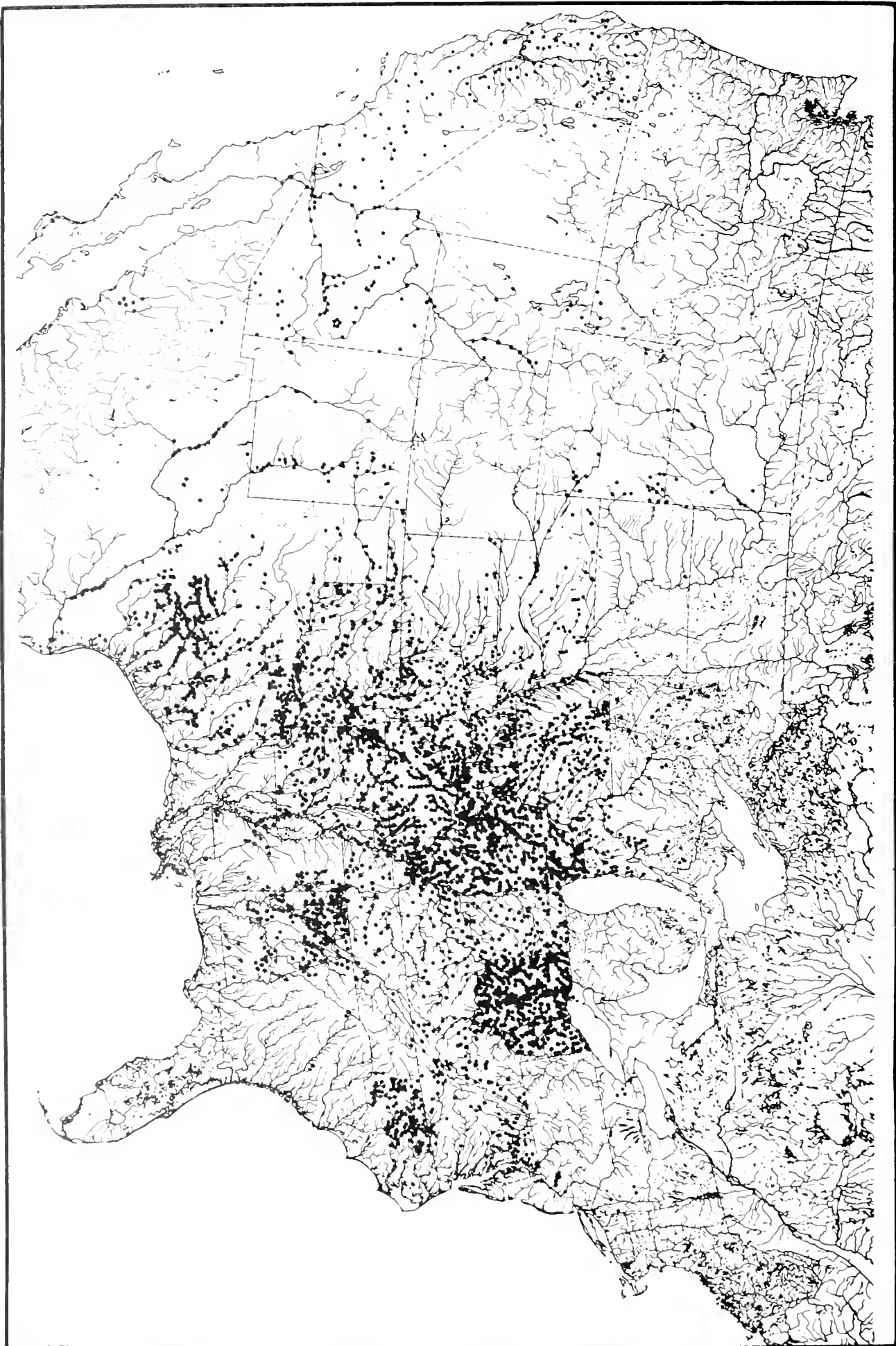
DISTRIBUTION AND HABITAT: Originally restricted to east-central North America, west to Appalachians from ON and NY to eastern ND, south to GA and northeastern Mexico. Widely introduced elsewhere in United States and in Germany. Ecologically tolerant of many habitats, but does not normally occur in brackish water.

ADULT SIZE: 150-250 mm TL.

BIOLOGY: Considerable information available on nearly all aspects of life history. Recent survey is provided by Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2). Hoffman (1967. *Parasites of North American Freshwater Fishes*) listed known parasites.

Compiler: D. S. Lee. March 1978.

Distribution of green sunfish, *Lepomis cyanellus*

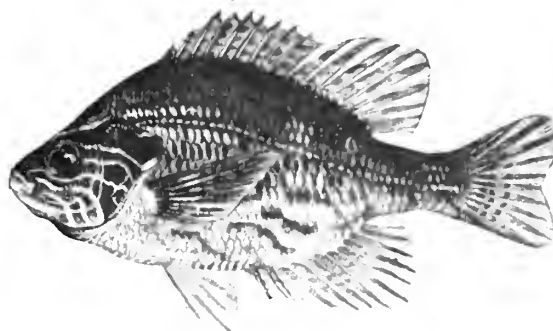


Lepomis gibbosus (Linnaeus)
Pumpkinseed

Order Perciformes
Family Centrarchidae

TYPE LOCALITY: "the Carolinas" (Linnaeus 1758. *Systema naturae* Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

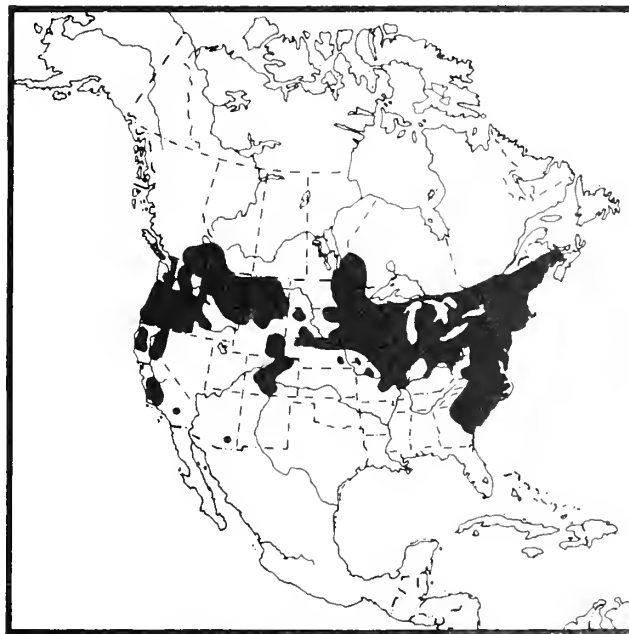
SYSTEMATICS: In material examined by Scott and Crossman (1973. *Freshwater Fishes of Canada*) only suggestion of meristic variability was slight tendency for individuals from western portion of range to have one additional dorsal and anal soft ray. Known to hybridize in nature with at least six other *Lepomis*. Scott and Crossman (1973) summarized nomenclature. Branson and Moore (1962. *Copeia*:1-108) indicated closest relatives to be *L. punctatus* and *L. microlophus*, based on study of acoustico-lateralis system. Avise and Smith (1977. *Syst. Zool.* 26: 319-35), analyzing biochemical characters, confirmed relationship to former species, but felt closest relationships are with *L. auritus*.



(N.C. Wildl. Resour. Comm.
and NCSM)



Former Distribution



Present Distribution

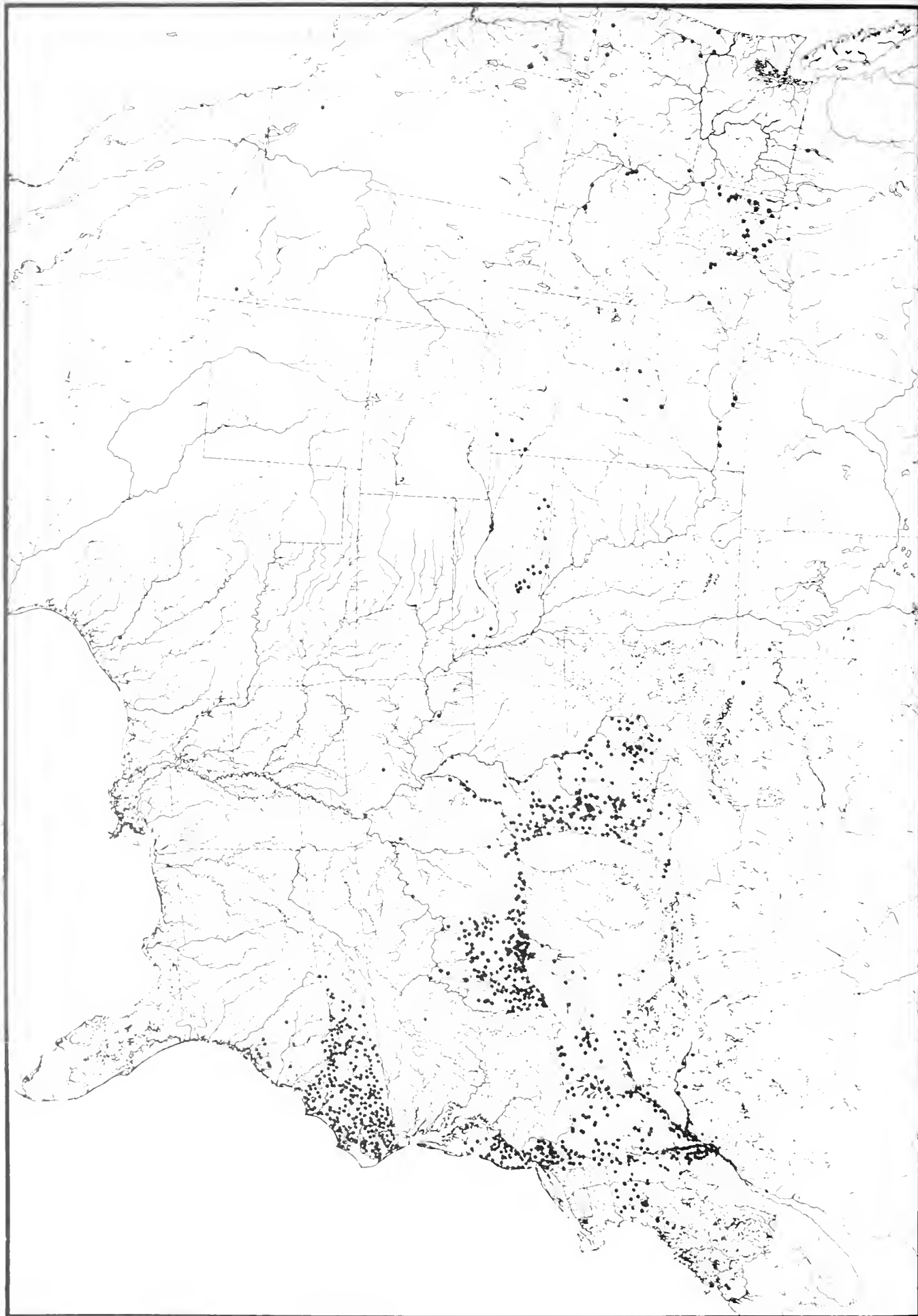
See map on next page

DISTRIBUTION AND HABITAT: Original distribution included much of Atlantic slope (NK to northern GA), Great Lakes drainage, and upper Mississippi basin (west to MO and SD). Transplanted into many states west of natural range and introduced into several European countries. Prefers quiet, clear water with aquatic vegetation and some organic debris. Generally lives in cooler water than most other *Lepomis*, and tends to inhabit denser vegetation than *L. macrochirus*. Occurs in large numbers in shallow, sheltered situations.

ADULT SIZE: 78-400 mm TL.

BIOLOGY: Adams and Hankinson (1928. *Roosevelt Wild Life Ann.* 1:241-542) discussed various aspects of life history in NY. Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) summarized data on length, weight, age, growth, spawning, feeding, digestion, and density. Scott and Crossman (1973) provided information on Canadian populations. Hoffman (1967. *Parasites of North American Freshwater Fishes*) listed parasites obtained from collections made from throughout range.

Compiler: D.S. Lee. May 1978.



Lepomis gulosus (Cuvier)
Warmouth

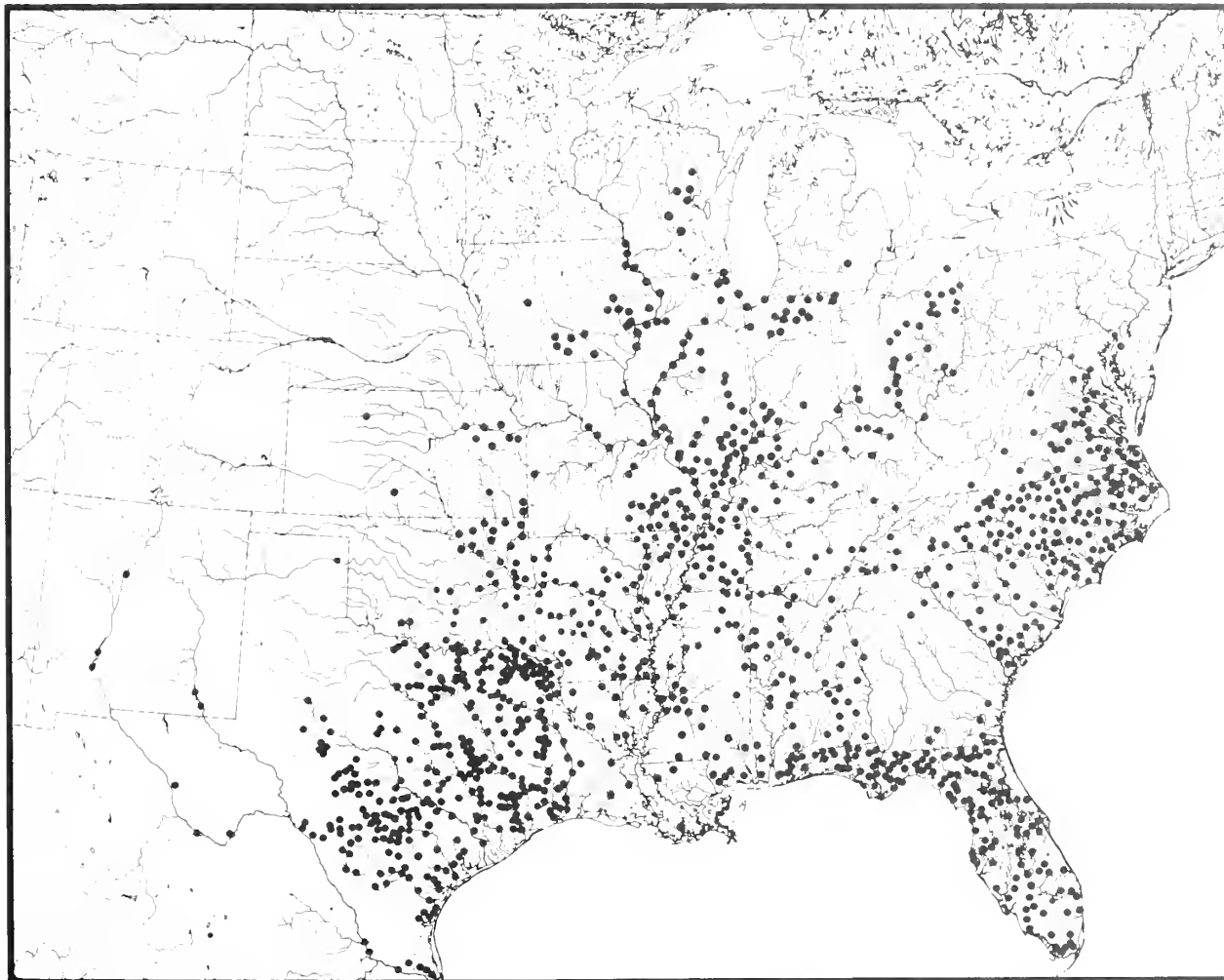
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Lake Pontchartrain, New Orleans, LA (Cuvier in Cuvier and Valenciennes 1829. *Histoire Naturelle des Poissons* 3:1-500).

SYSTEMATICS: Long placed in monotypic genus *Chaenobryttus*. Placed in *Lepomis* by Bailey et al. (1970. *Am. Fish. Soc. Spec. Publ.* 6:1-150). Known to hybridize with at least four other *Lepomis* spp., *Micropterus salmoides*, and *Pomoxis nigromaculatus*.



(N.C. Wildl. Resour. Comm.
and NCSM)



DISTRIBUTION AND HABITAT: Common in ponds, lakes, and occasionally streams, from KS and IA to southern WI, MI, and west PA, south to Rio Grande and FL. Presumed native on Atlantic slope north into VA, perhaps to MD. Transplanted west of Rockies and to portions of Atlantic slope. Occasionally reported in brackish water up to 4.1 ppt. Abundant where introduced in saline water of lowermost Colorado River, AZ (Minckley 1973. *Fishes of Arizona*).

ADULT SIZE: 75-260 mm TL; 284 mm TL maximum.

BIOLOGY: Larimore (1957. *Ill. Nat. Hist. Surv. Bull.* 27:1-83) studied life history in IL and found nesting from mid-May to August. Nests usually constructed near cover and guarded by male. Feeds mainly on insects, crayfish, and fish. Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) summarized published information and tabulated data on age, growth, length, and weight.

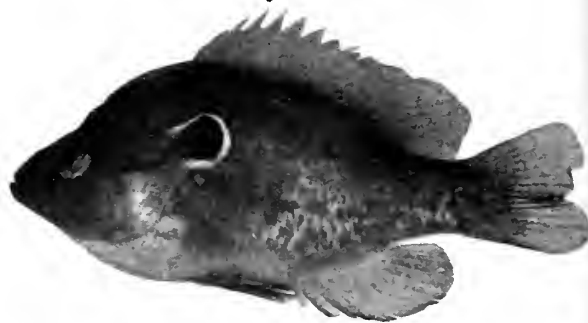
Compiler: D. S. Lee. December 1978.

Lepomis humilis (Girard)
Orangespotted sunfish

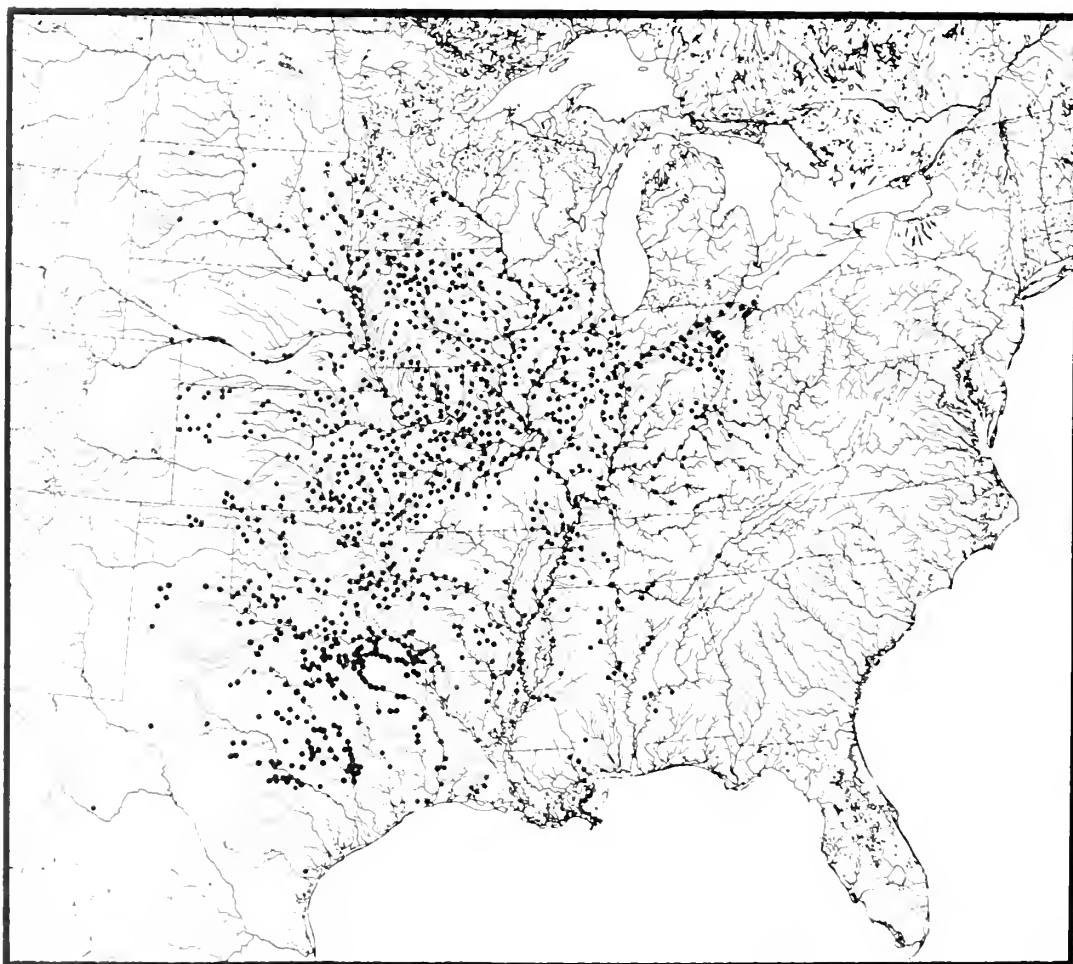
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: "Arkansas" (Girard 1858. Proc. Acad. Nat. Sci. Phila. 9:200-02).

SYSTEMATICS: Bailey (1938. Ph.D. diss., Univ. Michigan) reviewed systematics. Apparently most closely related to *L. macrochirus*.



OK: Garfield Co., Otter Creek,
72 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Mostly in quiet streams, but also vegetated lakes and ponds from ND to OH and south to TX and northern AL. Introduced farther east and west, though rarely intentionally. Known from salinity of 0.74 ppt. Smith (1968. Trans. Ill. State Acad. Sci. 61:31-45) noted that despite tolerance for silt, mud, and some pollutants, species was disappearing in IL study areas.

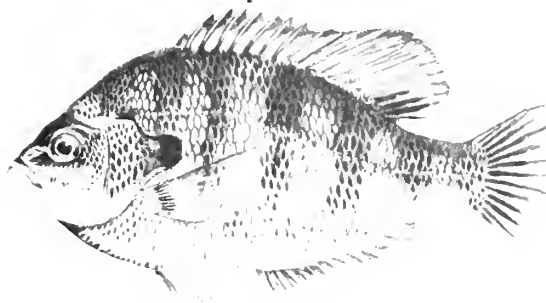
ADULT SIZE: 48-100 mm TL.

BIOLOGY: Nests May to July in northern portion of range and April to September in south. Parents guard nest. Insects constitute major food source. Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) provided synopsis of life history information and summarized known information on age, length, weight, and growth.

Compiler: D. S. Lee. December 1978.

Lepomis macrochirus Rafinesque
Bluegill

Order Perciformes
Family Centrarchidae



(N.C. Wildl. Resour. Comm.
and NCSM)

TYPE LOCALITY: "Ohio River" (Rafinesque 1819. J. Physique 88:417-29).

SYSTEMATICS: Three subspecies are recognized. *Lepomis m. macrochirus* occurs in the Great Lakes and north Mississippi basin. *L.m. speciosus* in TX and Mexico and *L.m. purpureus* on the Atlantic slope from coastal VA to FL (Hubbs and Lagler 1964. *Fishes of the Great Lakes Region*). Widespread introductions have resulted in extensive mixing of these gene pools. Avise and Smith (1974. *Evolution* 28:42-56) studied geographic variation and subspecific intergradation, and Avise and Smith (1977. *Syst. Zool.* 26:319-35) studied relationships to other centrarchid species using electrophoretic data. Commonly hybridizes with several other species of *Lepomis*, particularly in areas of ecological disturbance. Considered to be most closely related to *L. humilis* (Branson and Moore 1962. *Copeia*:1-108).



Former Distribution



Present Distribution

See map on next page

DISTRIBUTION AND HABITAT: Originally restricted to western and central North America where it ranged from coastal VA to FL, west to TX and northern Mexico, and north from western MN to western NY. Widely transplanted elsewhere in North America and introduced into Europe and South Africa. Inhabits shallow warm lakes, ponds, and slow-flowing rivers and creeks often with abundant aquatic vegetation.

ADULT SIZE: 178-203 mm TL, 405 mm TL maximum.

BIOLOGY: Spawning has been summarized by Breder and Rosen (1966. *Modes of Reproduction in Fishes*). This is a generalized wide spectrum feeder. Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) provided a lengthy summary and discussion of the general biology and of growth data obtained from numerous management studies.

Compiler: D.S. Lee. February 1978.

Distribution of bluegill, *Lepomis macrochirus*



Lepomis marginatus (Holbrook)
Dollar sunfish

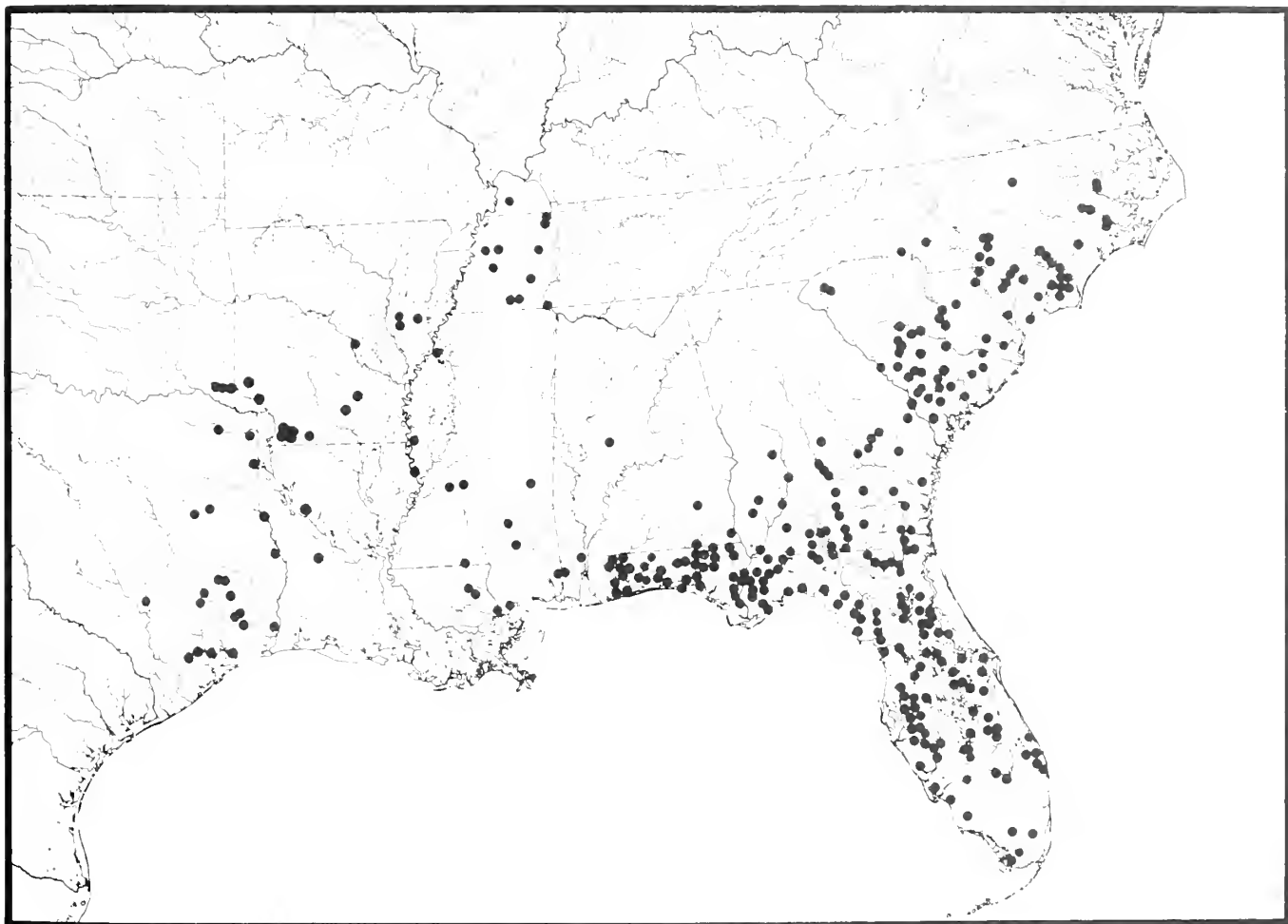
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: St. Johns River, FL (Holbrook 1855. J. Acad. Nat. Sci. Phila. [Ser. 2] 3:47-58).

SYSTEMATICS: Closest relative *L. megalotis*, the two comprising subgenus *Iethelis*. Considered monotypic by previous investigators, but recent studies by compiler indicate possible polytypy. Reeves and Moore (1949. Proc. Okla. Acad. Sci. 30:41-42) gave diagnostic characters for separation from *L. megalotis*.



AR: Calhoun Co., Locust Bayou, 72 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Southern coastal drainages from NC to TX and north through central Mississippi basin to KY and AR. Usually common to abundant. Species of swamps and sluggish streams.

BIOLOGY: Very little information available. McLane (1955 Ph.D. diss., Univ. Florida) classified it as insectivorous and reported breeding season as extending from April to September in St. John's River, FL.

ADULT SIZE: 36-100 mm SL.

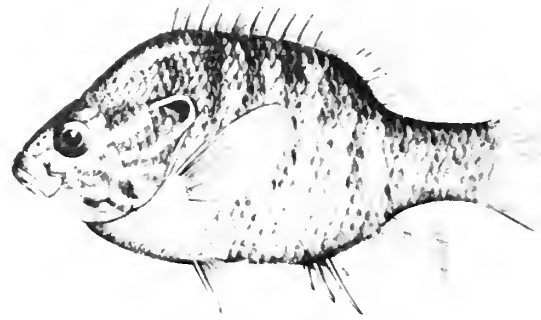
Compiler: B. H. Bauer. December 1978.

Lepomis megalotis (Rafinesque)
Longear sunfish

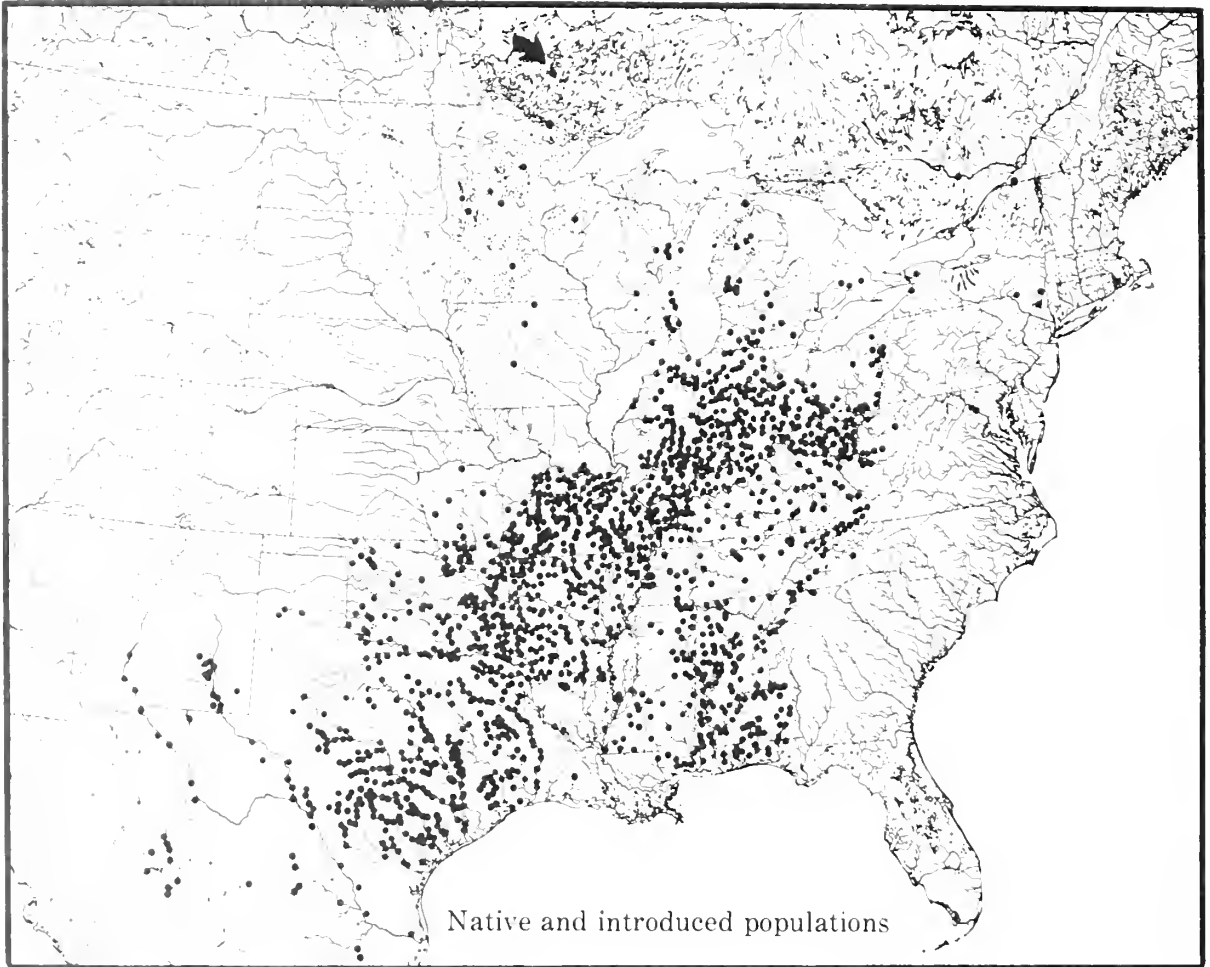
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Kentucky, Licking, and Sandy rivers, KY (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Closest relative *L. marginatus*, these two species comprising subgenus *Icthelis*. Hybridizes extensively with other *Lepomis*. Most polytypic member of family Centrarchidae, consisting of from four to six subspecies. Presently under study by compiler.



(NMC)



DISTRIBUTION AND HABITAT: Restricted to fresh waters of east-central North America. West of Appalachians, occurs from southern QU south to Gulf of Mexico in AL and western FL. Extends west through TX and Rio Grande tributaries in northeast Mexico, north through eastern parts of the states from OK to southern ON. Now thrives in reservoirs, but typically inhabits small streams and upland parts of rivers, generally absent from downstream lowland sections.

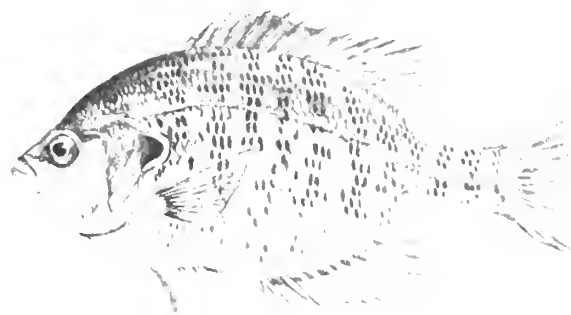
ADULT SIZE: 41 - 200 mm SL.

BIOLOGY: Various aspects of life history well studied. Hubbs and Cooper (1935. Pap. Mich. Acad. Sci. Arts Lett. 20:669-96) and Bacon and Kilambi (1968. Proc. Ark. Acad. Sci. 22:44-57) reported on age and growth. Applegate et al. (1966. Proc. 20th Ann. Conf. Southeast. Assoc. Game Fish Comm: 469-82) studied food habits. Numerous authors have studied breeding and mate selection behavior.

Compiler: B. H. Bauer. August 1978.

Lepomis microlophus (Günther)
Redear sunfish

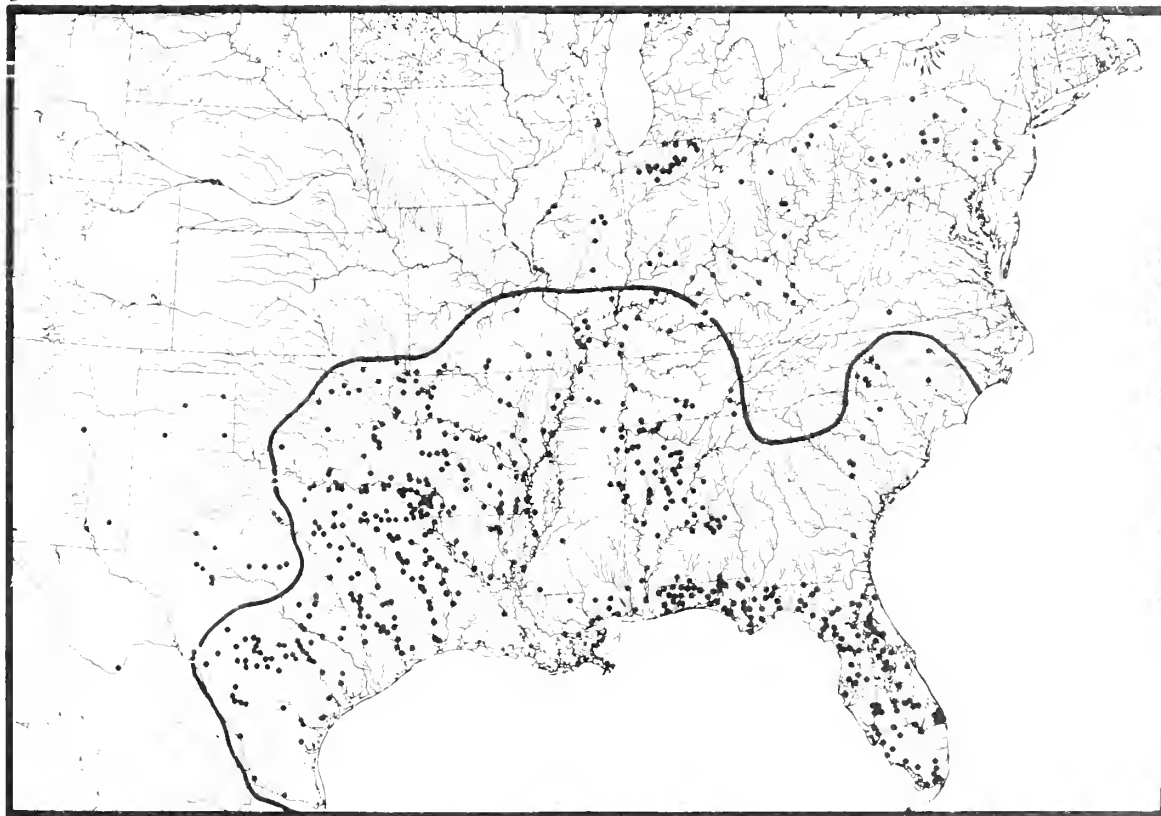
Order Perciformes
Family Centrarchidae



(N.C. Wildl. Resour. Comm.
and NCSM)

TYPE LOCALITY: St. Johns River, FL (Günther 1859. *Catalogue of the Fishes in the British Museum* 1:1-524).

SYSTEMATICS: Bailey (1938. Ph.D. diss., Univ. Michigan) concluded that *L. microlophus* comprises two distinct subspecies. Extensive introductions of stocks into ranges of each other have obscured natural relationships. Avise and Smith (1977. *Syst. Zool.* 26:319-35) on basis of electrophoretic data determined that most closely related species of *Lepomis* likely are *L. megalotis* and *L. marginatus*.



Line encloses native distribution

DISTRIBUTION AND HABITAT: Native to peninsular FL, lower Atlantic slope and Gulf slope drainages west to TX, and north to southern IN. Introduced into several areas outside natural range (western introductions not mapped). Common in warm, clear, quiet waters where vegetation, stumps, logs, and other cover abound. Occasionally in brackish water (12.3 ppt).

ADULT SIZE: 134-250 mm TL.

BIOLOGY: Aquatic snails are a major food item throughout range, but insect larvae and cladocerans also eaten. Seldom feeds at surface. Breeds throughout warmer months and normally matures by second year, although studies indicate considerable regional variation. Schoffman (1939. *J. Tenn. Acad. Sci.* 14:61-71) found that TN "shellcrackers" average 109 mm TL in second summer, and 152, 175, 190, and 206 mm TL in succeeding summers. Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) provided synopsis of literature and summary of information on age, weight, and growth.

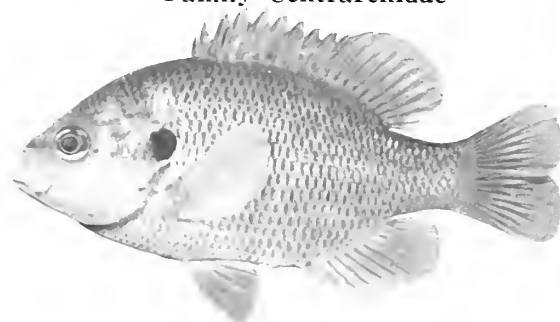
Compiler: D. S. Lee. November 1978.

Lepomis punctatus (Valenciennes)
Spotted sunfish

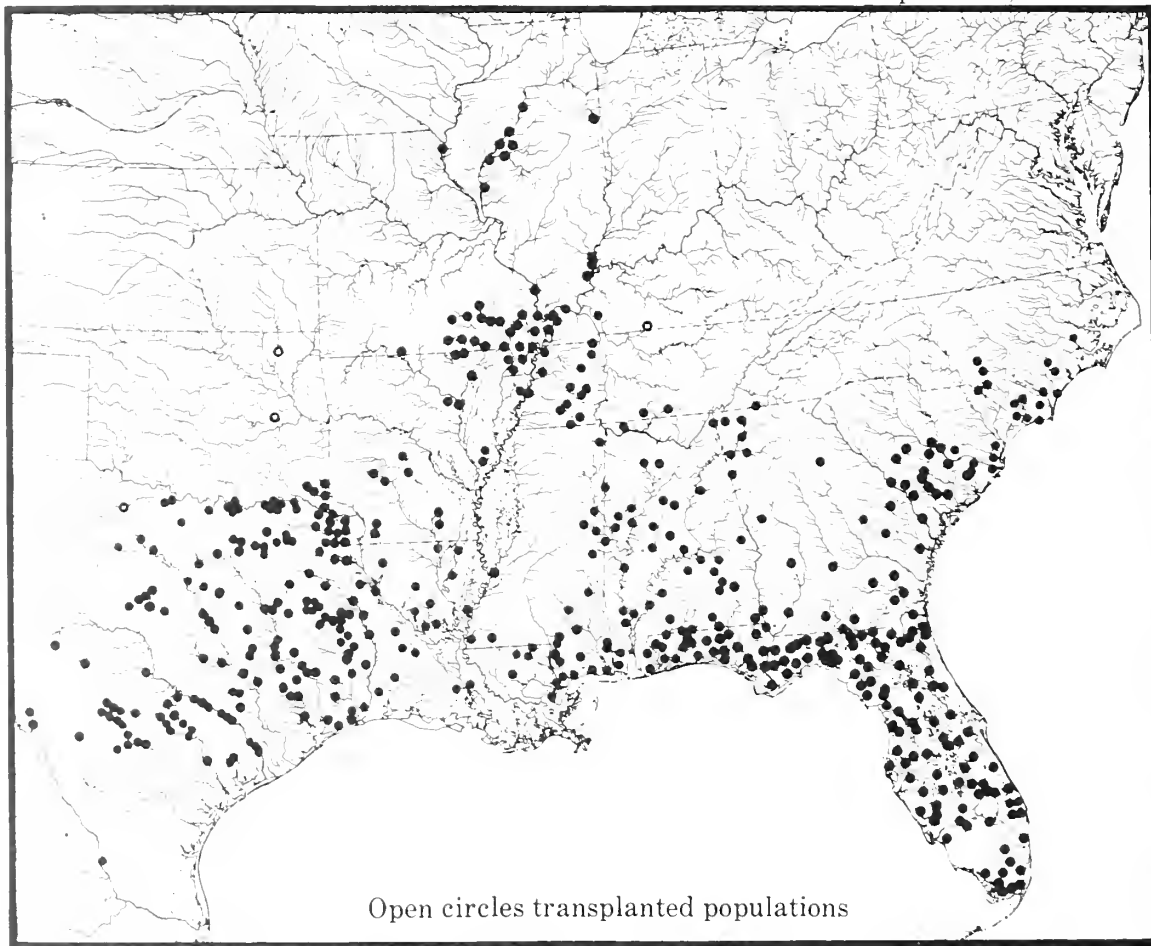
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Charleston, SC (Valenciennes in Cuvier and Valenciennes 1831. *Histoire Naturelle des Poissons* 7: 1-531).

SYSTEMATICS: Two subspecies recognized: *L. p. punctatus* ranging from NC to FL, and *L. p. miniatus* in Mississippi and most Gulf slope drainages; zone of intergradation apparently in extreme west FL (Carr and Goin 1959. *The Reptiles, Amphibians, and Freshwater Fishes of Florida*) and probably AL.



MO: New Madrid Co.,
Sikeston, 111 mm SL (Mo.
Dept. Cons.).



DISTRIBUTION AND HABITAT: Southeastern United States from eastern TX east to and including peninsular FL, north along Atlantic slope to southeastern NC. In Mississippi basin north to IL. Common in quiet or moderately flowing waters with heavy vegetation or other cover.

ADULT SIZE: 55-140 mm SL, ca. 200 mm TL maximum.

BIOLOGY: Forbes and Richardson (1920. *The Fishes of Illinois*) reported spawning in May in IL. Pflieger (1975. *The Fishes of Missouri*) noted nesting in July in MO and commented on various aspects of life history. Carr (1946. Q. J. Fla. Acad. Sci. 9:101-06) studied courtship, spawning, and nest defense habits in FL, and recorded spawning from early spring to November. Courting males make grunting sounds (Gerald 1971. *Evolution* 25:25-87). Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) summarized available weight, age, and growth information.

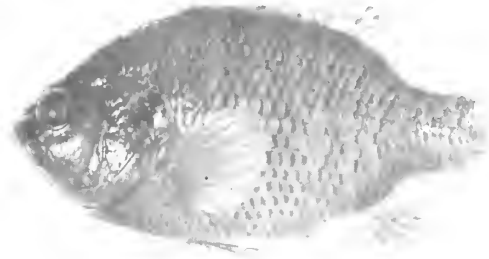
Compiler: D. S. Lee. November 1978.

Lepomis symmetricus Forbes
Bantam sunfish

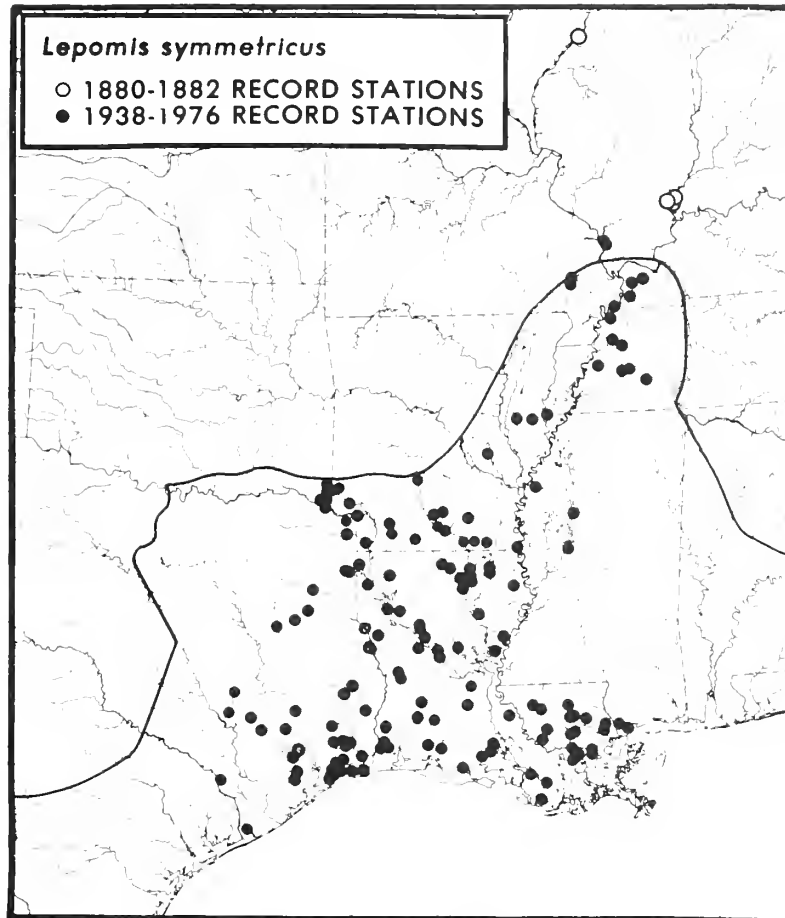
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Illinois River at Pekin, Tazewell Co., IL (Forbes in Jordan and Gilbert 1883. U. S. Natl. Mus. Bull. 16:473-74).

SYSTEMATICS: Based on morphology (Bailey 1938. Ph.D. diss., Univ. Michigan, Ann Arbor) and components of acoustico-lateralis system (Branson and Moore 1962. Copeia:1-108), closest relative is probably *L. cyanellus*.



IL: Union Co., Wolf Lake, male,
54 mm SL (Burr 1977).



Map modified from Burr 1977
Solid line indicates Fall Line

DISTRIBUTION AND HABITAT: Primarily western part of Gulf Coastal Plain in lower Mississippi Valley. Formerly occurred above Fall Line in lower Wabash River and central Illinois River, IL. Found predominantly in lowland sloughs, oxbows, lakes, ponds, and swamps with a mud bottom; often associated with heavy vegetation, stumps and logs.

ADULT SIZE: 35-65 mm SL.

BIOLOGY: Definitive study and summary of previous literature by Burr (1977. Ill. Nat. Hist. Surv. Bull. 31:437-66).

Compiler: B. M. Burr. February 1978.

Micropterus coosae Hubbs and Bailey
Redeyed bass

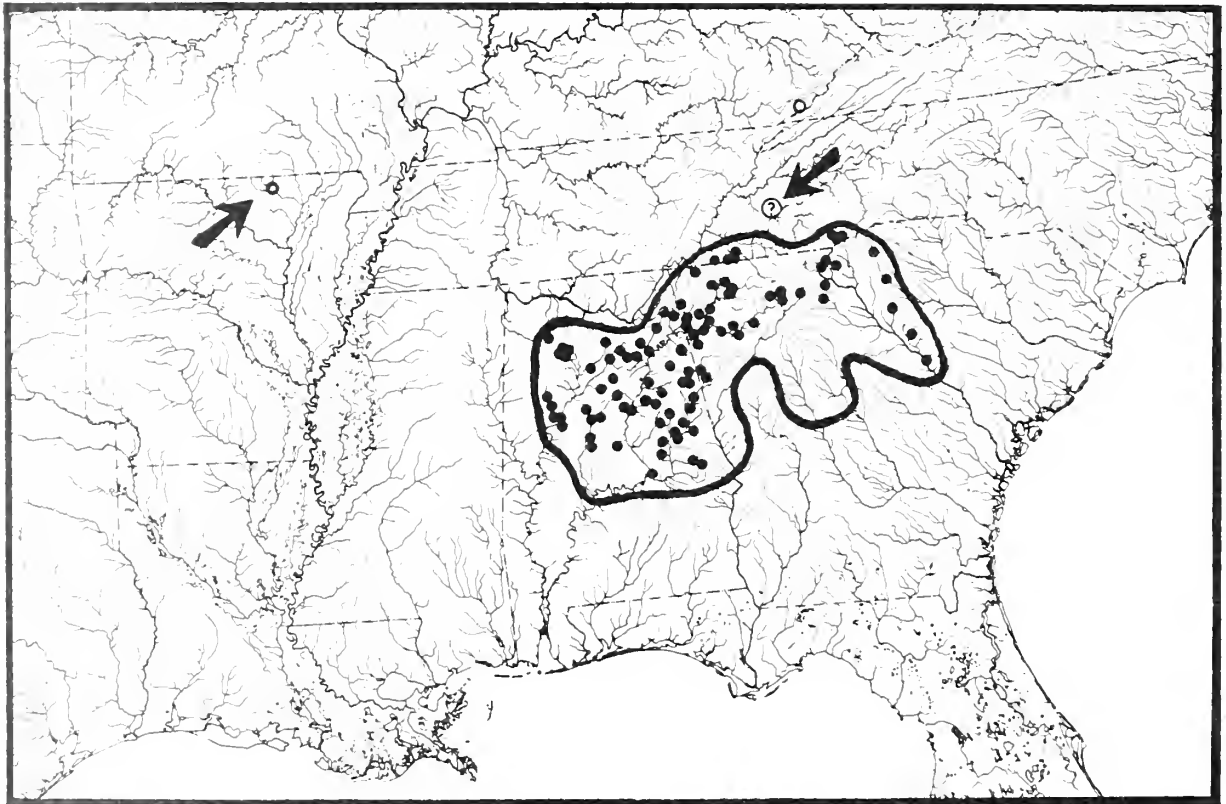
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Fisher Creek, tributary to Big Will's Creek of Coosa River system, between Altalla and Boaz, Etowah Co., AL (Hubbs and Bailey 1940. Misc. Publ. Mus. Zool., Univ. Mich. 48:23-28).

SYSTEMATICS: Closest relative is undescribed "shoal bass," which is endemic to Apalachicola River drainage. Similar in structural features to *M. punctulatus* and assumed more closely related to it than to *M. dolomieu*.



GA: Gordon Co., Coosa River system, 143 mm SL (Smith-Vaniz 1968).



Open circles transplanted populations
Line encloses native distribution

DISTRIBUTION AND HABITAT: Originally reported from AL (Alabama and Chattahoochee River system) and GA (Coosa, Chattahoochee, and Savannah River systems). Subsequent report from Warrior River assumed based on native population, but all other records, including those from below Fall Line considered result of stocking (Ramsey 1973. ASB Bull. 20:76). Inhabits small to large streams. Introduced into California and Puerto Rico (not mapped). Moyle (1976. *Inland Fishes of California*.) summarized current status and distribution in CA. Apparently introduced to upper Cumberland River drainage, KY.

ADULT SIZE: ca. 120-390 mm SL.

BIOLOGY: Parsons (1954. Trans. Am. Fish Soc. 83:202-11) provided information on growth, feeding, habitat preference, and spawning and other behavior. Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) summarized available information on SL, weight, age, and fecundity.

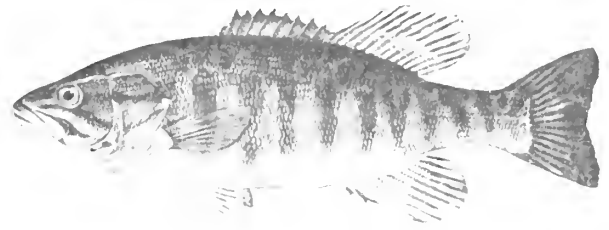
Compiler: D. S. Lee. September 1978.

Micropterus dolomieu Lacepede
Smallmouth bass

Order Perciformes
Family Centrarchidae

TYPE LOCALITY: None given (Lacepede 1802. *Histoire Naturelle des Poissons* 4: 1-728).

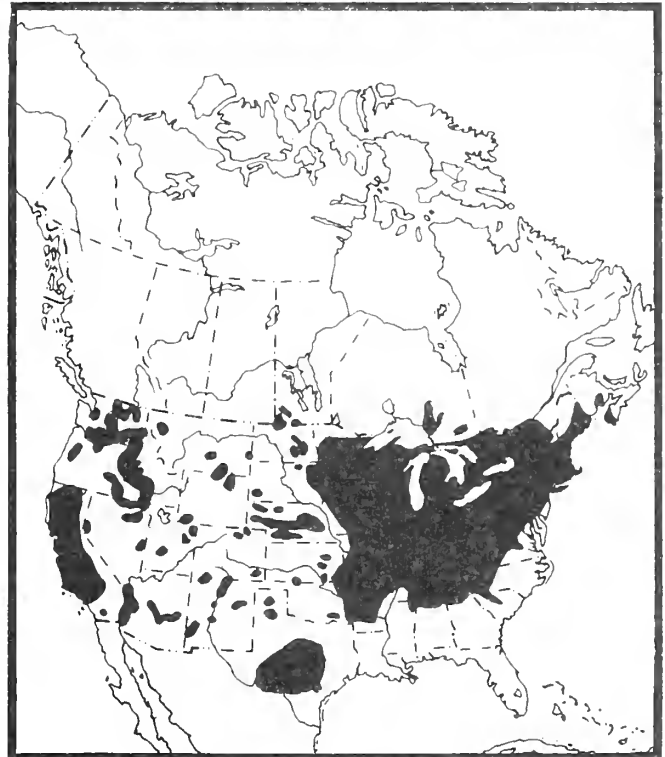
SYSTEMATICS: Hubbs and Bailey (1940. Misc. Publ. Mus. Zool. Univ. Mich. 48:1-51) recognized two subspecies: *M. d. dolomieu* east of Mississippi River and from central MO north; and *M. d. velox* from middle Arkansas River drainage. Intergrades identified from White and Black river drainages, AR and MO, and Ouachita River system, AR. Widely introduced and genetic integrity of original stocks may no longer be valid. Summary of nomenclature in Scott and Crossman (1973. *Freshwater Fishes of Canada*).



(N.C. Wildl. Resour. Comm.
and NCSM)



Former Distribution



Present Distribution

DISTRIBUTION AND HABITAT: Originally from MN and southern QU south to Tennessee River system in AL and west to eastern OK (Hubbs and Bailey 1938. Cranbrook Inst. Sci. Bull. 10:1-89). Widely transplanted elsewhere in this country and abroad. Robbins and MacCrimmon (Biomang. Res. Enterp. P6A5Pa: 1-196) provided extensive summary of stocking. Prefers clear, fast-flowing streams and flowing pools with gravel-rubble bottom.

ADULT SIZE: ca. 200-560 mm TL, 686 mm TL maximum.

BIOLOGY: Because of importance as game fish, species has been intensively studied. Good summaries provided by Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2), Scott and Crossman (1973) Adams and Hankinson (1928. Roosevelt Wild Life Ann. 1:235-548), and Stroud and Clepper ([eds.] 1975. *Black Bass Biology and Management*).

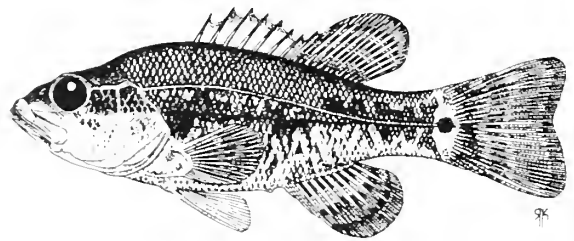
Compiler: D. S. Lee. February 1978.

Micropterus notius Bailey and Hubbs
Suwannee bass

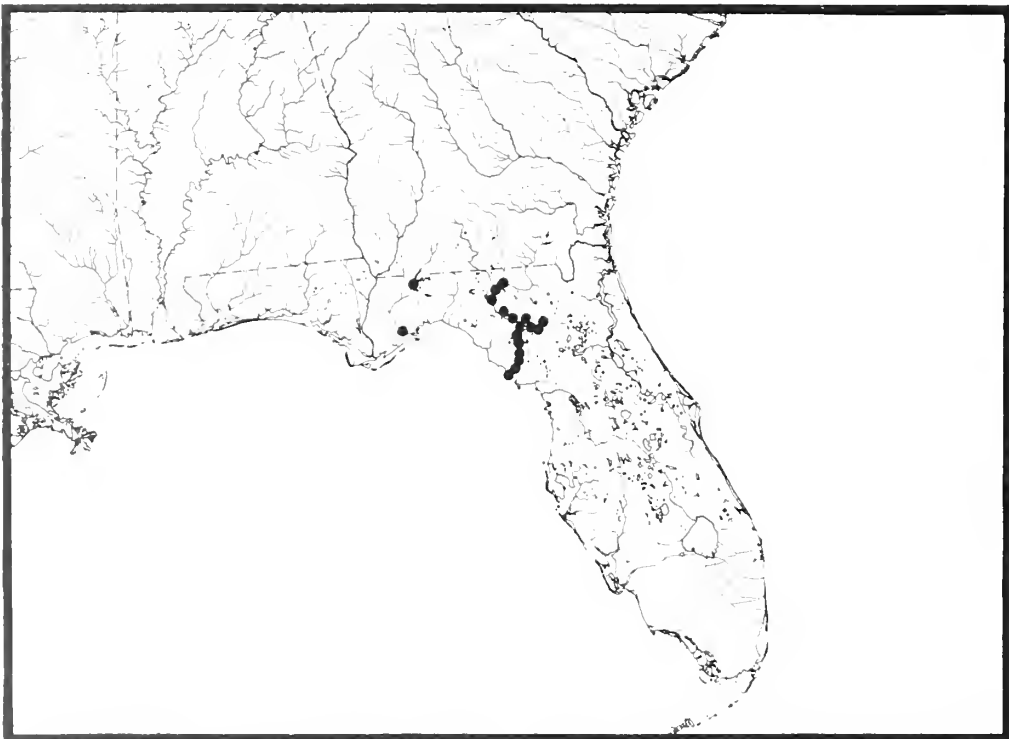
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Ichetucknee Springs (tributary to Suwannee River), Columbia Co., FL (Bailey and Hubbs 1949. Occas. Pap. Mus. Zool. Univ. Mich. 516:1-40).

SYSTEMATICS: Considered by Bailey and Hubbs (1949) and Ramsey (in Stroud and Clepper [eds.] 1975, *Black Bass Biology and Management*:67-75) to be most generalized species of genus. Ramsey (1972. Proc. 25th Ann. Conf. SE Assoc. Game Fish Comm. [1971]:348-56) compared juveniles with those of other *Micropterus* species. Swift et al. (1977. Bull. Tall Timbers Res. Sta. 20:1-111) presented meristic data for five specimens from Ochlockonee River drainage, FL.



FL: Columbus Co., Ichetucknee River, 58 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Restricted to Suwannee River drainage, FL, and Ochlockonee River drainage, FL and GA. Although not mapped here, reported by fishermen to occur in Ochlockonee River, GA, as far upstream as U.S. hwy. 84 bridge (Swift et al. 1977). Occurs upstream in Suwannee River to mouth of Alapaha River. Most common in lower 48.4 km of Santa Fe River (tributary to Suwannee) (Hellier 1967. Bull. Fla. State Mus. Biol. Sci. 11:1-37; Bass and Hitt 1973. Distribution and life history aspects of the Suwannee bass, *Micropterus notius*. Mimeo. Rept. Fla. Game Fresh Water Fish Comm:1-54). Mostly confined to flowing waters of rocky shoal areas; also in large springs and spring runs. Moderately common in preferred habitat, particularly in Suwannee River drainage.

ADULT SIZE: 125-300 mm SL.

BIOLOGY: Bass and Hitt (1973) studied biology in Suwannee River drainage, and their results summarized by Hurst et al. (in Stroud and Clepper [eds.] 1975: 47-53). Hellier (1967) presented monthly length-frequency data from Santa Fe River, FL. Gilbert (in Gilbert [ed.] 1978. *Rare and Endangered Biota of Florida* 4:43-44) summarized biological data. Feeds mostly on crayfish, and to lesser extent on fish and shrimp. Spawns February to June, with onset of spawning occurring at 18-20°C. Although often found with *M. salmoides*, Suwannee bass generally prefers more rapidly flowing water.

Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Micropterus punctulatus (Rafinesque)
Spotted bass

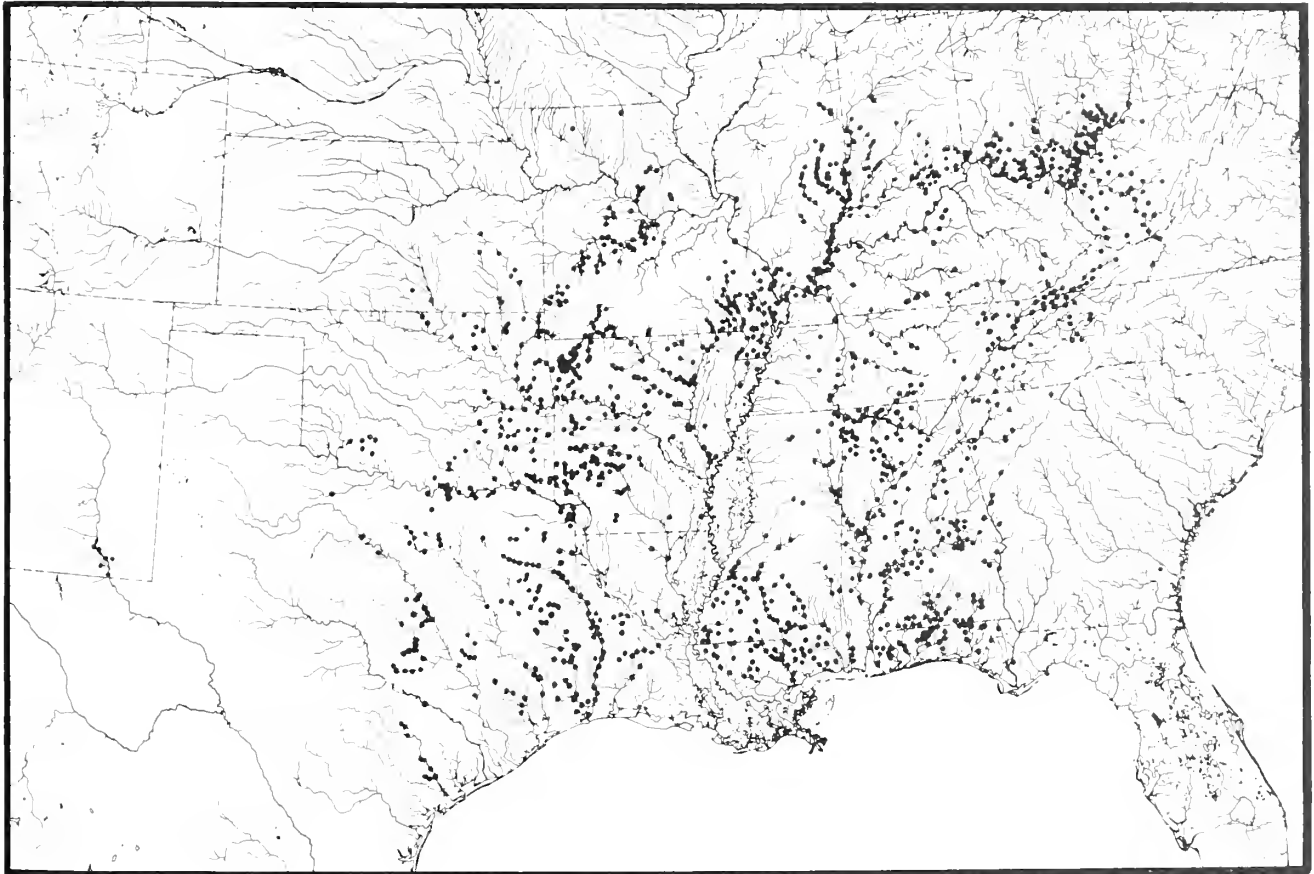
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Ohio River (Rafinesque 1819. J. Phys. Chim. Hist. Nat. Arts 88: 417-29).

SYSTEMATICS: Synonymies, descriptions, and relationships of the three recognized subspecies presented in Hubbs and Bailey (1940. Misc. Publ. Mus. Zool. Univ. Mich. 48:1-51), Bailey and Hubbs (1949. Occas. Pap. Mus. Zool. Univ. Mich. 516:1-40) and Ramsey (*in* Stroud and Clepper [eds.] 1975. *Black Bass Biology and Management*:67-75).



AL: Elmore Co., Coosa River system (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Throughout central and lower Mississippi basin and along Gulf coast from western TX through northwestern FL. Northern spotted bass, *M. p. punctulatus*, appears introduced in Apalachicola drainage, GA-AL, and recently has been introduced in Cape Fear drainage, NC, and Roanoke and James drainages, VA. Alabama spotted bass, *M. p. henshalli*, introduced in CA. Wichita spotted bass, *M. p. wichitae*, apparently restricted to West Cache Creek, OK. *Micropterus p. punctulatus* prefers larger streams and rivers (Robbins and MacCrimmon 1974. The blackbass in America

and overseas :97-108), whereas *M. p. henshalli* occurs in smaller streams and rivers and is especially abundant in large, deep, oligotrophic reservoirs of upper Mobile Bay drainage (Gilbert 1973. Ph.D. diss., Auburn Univ.) Usually common.

ADULT SIZE: 250-350 mm SL.

BIOLOGY: Vogele (*in* Stroud and Clepper [eds.] 1975. *Black Bass Biology and Management*:34-45) discussed biology of all subspecies.

Compiler: R. J. Gilbert. July 1979.

Micropterus salmoides (Lacepede)
Largemouth bass

Order Perciformes
Family Centrarchidae

TYPE LOCALITY: "les rivieras de le carolina"; Charleston, SC, regarded as probable type locality (Lacepede 1802. *Histoire Naturelle des Poissons* 4:1-728).

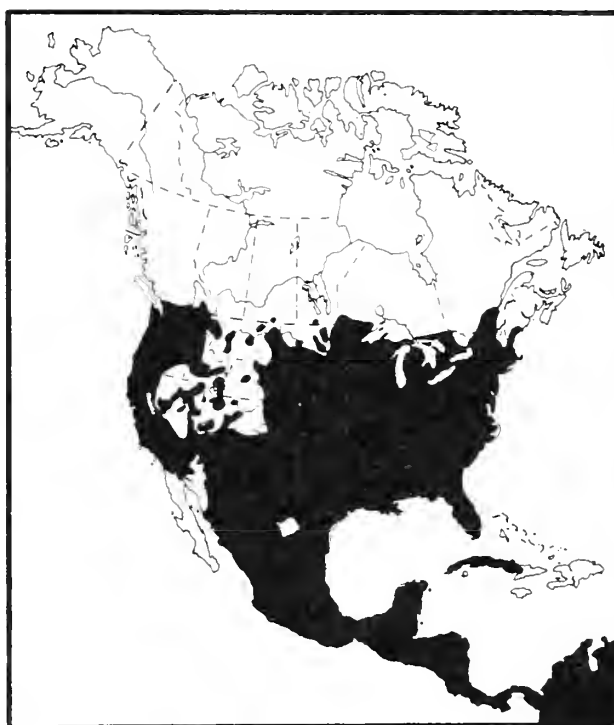
SYSTEMATICS: Subfamily Lepominae, tribe Micropterini. Formerly placed in monotypic genus *Huro* (Hubbs 1926. *Misc. Publ. Mus. Zool. Univ. Mich.* 15:1-77; Hubbs and Bailey 1940. *Misc. Publ. Mus. Zool. Univ. Mich.* 48:1-51). Hubbs and Bailey (1940) reviewed systematics, and Bailey and Hubbs (1949. *Occas. Pap. Mus. Zool. Univ. Mich.* 516:1-40) defined and mapped distinctive subspecies, *M. s. floridanus*, endemic to peninsular FL.



(N.C. Wildl. Resour. Comm.
and NCSM)



Former Distribution



Present Distribution

DISTRIBUTION AND HABITAT: Original range from northeastern Mexico to FL, much of Mississippi River, north to southern QU and ON and on Atlantic slope north only to southern or central SC. Precise original distribution masked by numerous undocumented transplants. Robbins and MacCrimmon (1974. *Biomanag. Res. Cent.* 1:1-196) extensively surveyed nearly worldwide introductions. Prefers clear, quiet waters with aquatic vegetation. Common to abundant throughout most of range.

ADULT SIZE: ca. 120 mm - 700 mm TL.

BIOLOGY: One of most important North American gamefish and much information available. Summaries of life history and propagation information available in Scott and Crossman (1973. *Freshwater Fishes of Canada*) and Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2). Heidinger (1974. *An Indexed Bibliography of the Largemouth Bass, Micropterus salmoides*) provided extensive bibliography.

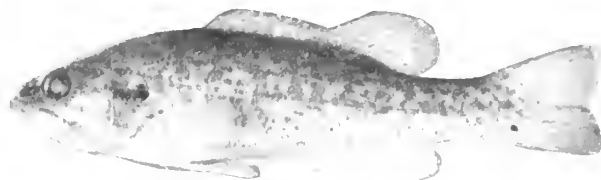
Compiler: D. S. Lee. February 1978.

Micropterus treculi (Vaillant and Bocourt)
Guadalupe bass

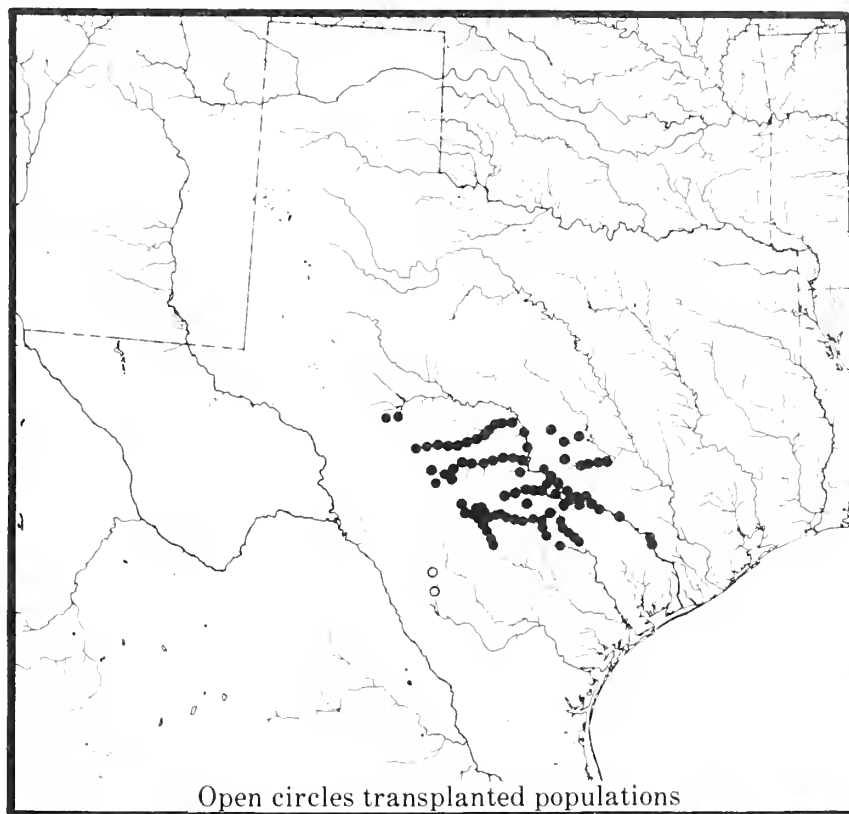
Order Perciformes
Family Centrarchidae

TYPE LOCALITY: Near San Antonio, TX (Vaillant and Bocourt 1874. Mission scientifique au Mexique et dan l'Amerique Centrale).

SYSTEMATICS: Misidentified or placed in synonymy of other *Micropterus* species or subspecies until recognized as distinct subspecies of *M. punctulatus* by Hubbs and Bailey (1942. Occas. Pap. Mus. Zool. Mich. 457:1-11). Elevated to specific status by Clark Hubbs (1954. Tex. J. Sci. 6:277-91). Placed in *M. punctulatus* lineage, subgenus *Micropterus*, by Ramsey (in Stroud and Clepper [eds.] 1975. *Black Bass Biology and Management*: 67-75), with closest affinities to *M. punctulatus wichitae*.



TX: Hays Co., Blanco River.
93 mm SL (J.L. Harris).



DISTRIBUTION AND HABITAT: Limited to eastern side of Edwards Plateau drained by San Antonio River headwaters: Guadalupe River above Gonzales; Colorado River from Austin upstream; and Lampasas, Little, and Leon rivers of Brazos River drainage. Prefers lentic habitats. Abundant in downstream sections of small streams, where it inhabits shallow, swift waters, often occurring in riffles or at the head of pools. Absent from extreme headwaters. Moderately tolerant of high turbidity and variable temperatures.

ADULT SIZE: ca. 2 kg maximum.

BIOLOGY: Little known. Brief accounts presented by Hurst et al. (in Stroud and Clepper [eds.] 1975:47-53) and Robbins and MacCrimmon (1974. *The Black Bass in America and Overseas*). Smitherman (in Clepper and Stroud [eds.] 1975. :76-84) described culture in farm ponds.

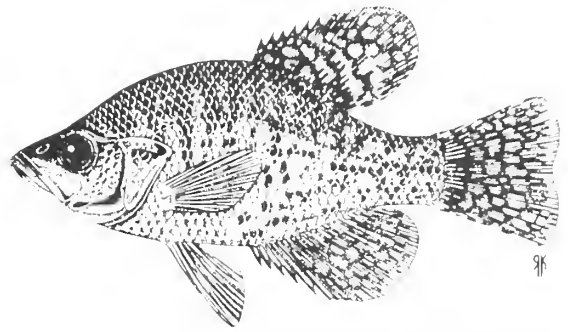
Compiler: V. Guillory. November 1978.

Pomoxis annularis Rafinesque
White crappie

Order Perciformes
Family Centrarchidae

TYPE LOCALITY: "Ohio River" (Rafinesque 1818. Am. Mon. Mag. Crit. Rev. 4:39-42).

SYSTEMATICS: Subfamily Centrarchinae, tribe Centrarchini. Branson and Moore (1962. Copeia:1-108) studied morphology of acoustico-lateralis system and determined closest generic relationships to be with *Centrarchus*. Avise et al. (1977. Copeia: 250-58), based on electrophoretic data, suggested relationships might be closer to *Lepomis* and *Micropterus*, subfamily Lepominae. Bailey (1938. Ph.D. diss., Univ. Michigan) reviewed systematics. Known to hybridize naturally with *P. nigromaculatus*; artificially crossed with other genera (Schwartz 1972. Publ. Gulf Coast Res. Lab. Mus. 3:1-328).



MD: Garrett Co., Piney Creek.
165 mm SL (NCSM).



Former Distribution



Present Distribution

See map on next page

DISTRIBUTION AND HABITAT: Natural range restricted to freshwaters of east central North America from southern ON and southwestern NY west of Appalachians, south to Gulf coast and west to TX, SD, and southern MN. Widely introduced into other suitable waters in United States. Apparently more tolerant of turbidity and siltation than *P. nigromaculatus*. Occurs in streams, lakes, ponds, and slow-moving areas of large rivers.

ADULT SIZE: ca. 170-330 mm TL.

BIOLOGY: Hansen (1951. Bull. Ill. Nat. Hist. Surv. 25:211-65; 1965. Trans. Am. Fish. Soc. 94:182-84) and Siefert (1968. Trans. Am. Fish. Soc. 97:252-59) provided much information. Biology summarized by Scott and Crossman (1973. *Freshwater Fishes of Canada*). Pflieger (1976. *The Fishes of Missouri*) presented information on life history in MO, and Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) offered data on comparative growth.

Compiler: D. S. Lee. February 1978.

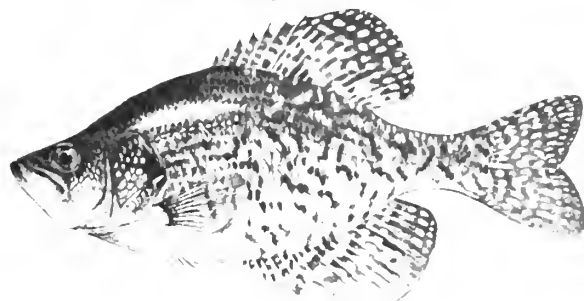
Distribution of white crappie, *Pomoxis annularis*



Pomoxis nigromaculatus (Lesueur)
Black crappie

Order Perciformes
Family Centrarchidae

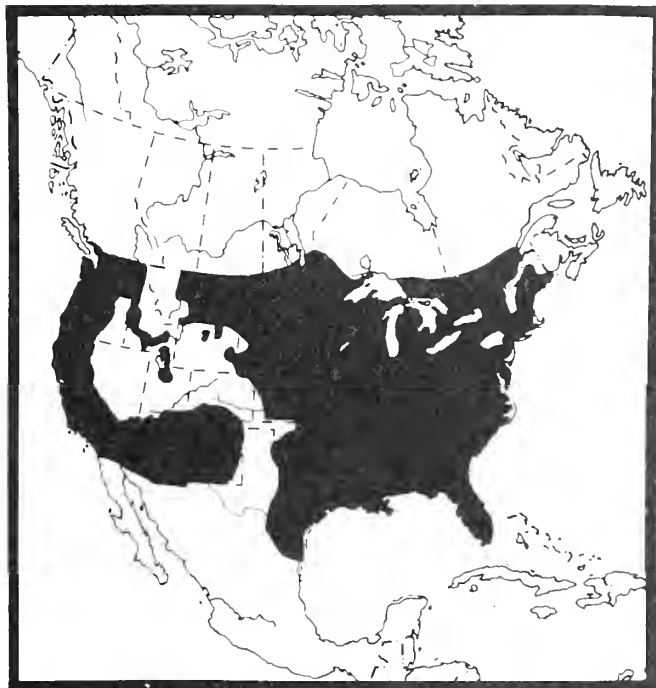
TYPE LOCALITY: Wabash River, OH (Lesueur in Cuvier and Valenciennes 1829. *Histoire Naturelle des Poissons* 3:1-500).
SYSTEMATICS: Subfamily Centrarchinae, tribe Centrarchini. Branson and Moore (1962. Copeia:1-108) studied morphology of acoustico-lateralis system and determined closest generic relationships to be with *Centrarchus*. Avise et al. (1977. Copeia: 250-58), based on electrophoretic data, suggested relationships might be closer to *Lepomis* and *Micropterus*, subfamily Lepominae. Bailey (1938. Ph.D. diss., Univ. Michigan) reviewed systematics. Known to hybridize naturally with *P. annularis*; artificially crossed with other genera (Schwartz 1972. Publ. Gulf Coast Res. Lab. Mus. 3:1-328).



(N.C. Wildl. Resour. Comm.
and NCSM)



Former Distribution



Present Distribution

See map on next page

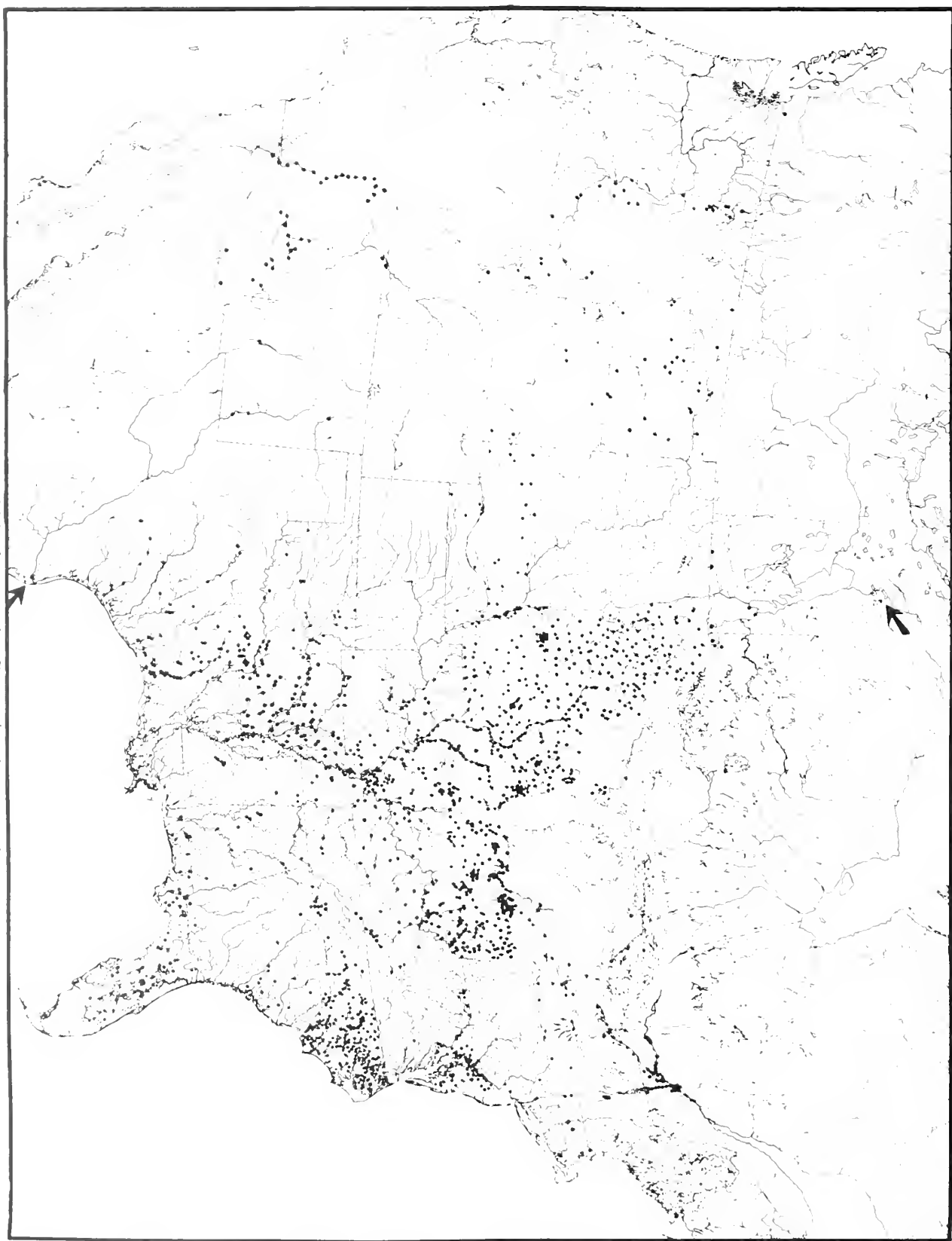
DISTRIBUTION AND HABITAT: So widely transplanted that reconstruction of native range is difficult. Apparently native along Atlantic slope from VA to FL, along Gulf Coast to central TX north to ND and eastern MT, and east to Appalachians. Widely transplanted elsewhere in North America. Occurs in quiet warm waters; usually associated with abundant aquatic vegetation and sandy to muddy bottoms. Inhabits large ponds and shallow areas of lakes. Generally prefers cleaner, deeper and cooler waters than *P. annularis*.

ADULT SIZE: ca. 130-420 mm TL.

BIOLOGY: Hansen (1951. Bull. Ill. Nat. Hist. Surv. 25:211-65) studied biology in IL. Huish (1954. Trans. Am. Fish. Soc. 83: 176-93) examined life history of a population in Lake George, FL. Carlander (1977. *Handbook of Freshwater Fishery Biology* Vol. 2) summarized age, growth, size, and weight data, and feeding behavior through entire range. Keast's (1968. J. Fish Res. Board Can. 25:285-97) survey of literature concerning feeding biology suggested similar food habits throughout range.

Compiler: D. S. Lee. February 1978.

Distribution of black crappie, *Pomoxis nigromaculatus*

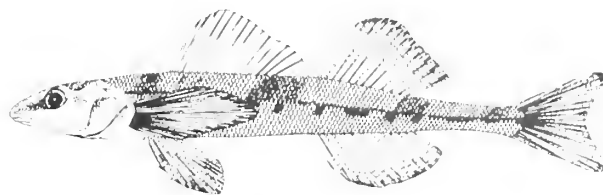


Ammocrypta asprella (Jordan)
Crystal darter

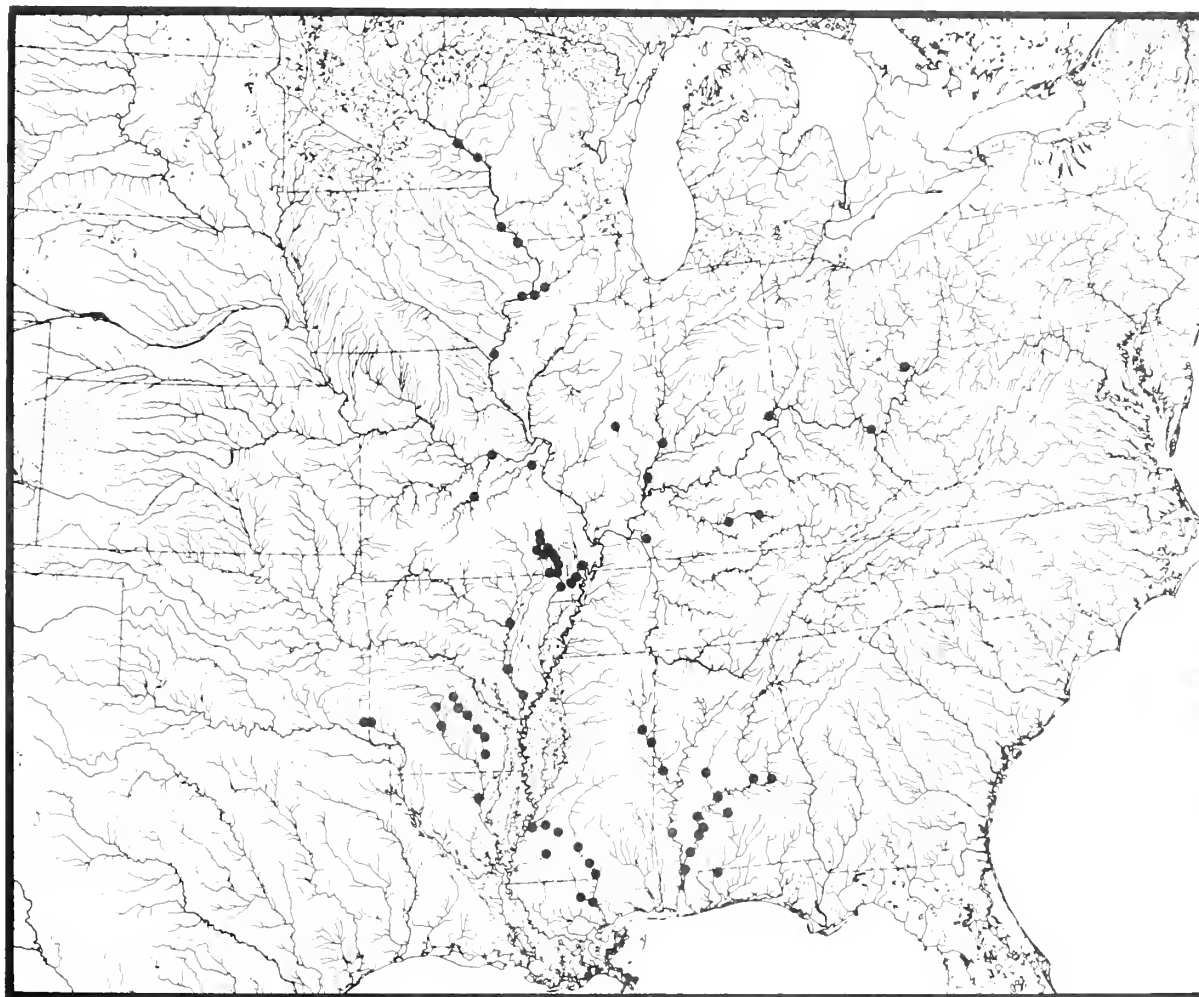
Order Perciformes
Family Percidae

TYPE LOCALITY: Small rocky tributary of Mississippi River, Hancock Co., IL (Jordan 1878. Bull. Ill. State Lab. Nat. Hist. 1: 37-70).

SYSTEMATICS: Subgenus *Crystallaria*. One of the most distinctive darters, considered by some to constitute monotypic genus (Moore in Blair et al. 1968. *Vertebrates of the United States*).



(Smith 1979. *The Fishes of Illinois*)



DISTRIBUTION AND HABITAT: Historically from WI and MN east to OH and south to OK, LA, AL, and FL. Distribution now sporadic; common only in a few large, clear streams and rivers with expanses of clean sand and gravel.

BIOLOGY: Buries in sand with only eyes protruding and darts at passing prey (Miller and Robison 1973. *The Fishes of Oklahoma*).

ADULT SIZE: 50-130 mm SL.

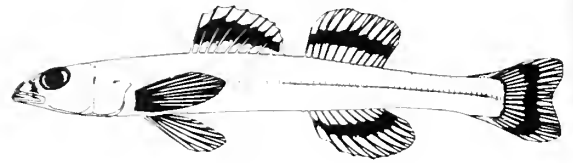
Compiler: L. M. Page. December 1978.

Ammocrypta beani Jordan
Naked sand darter

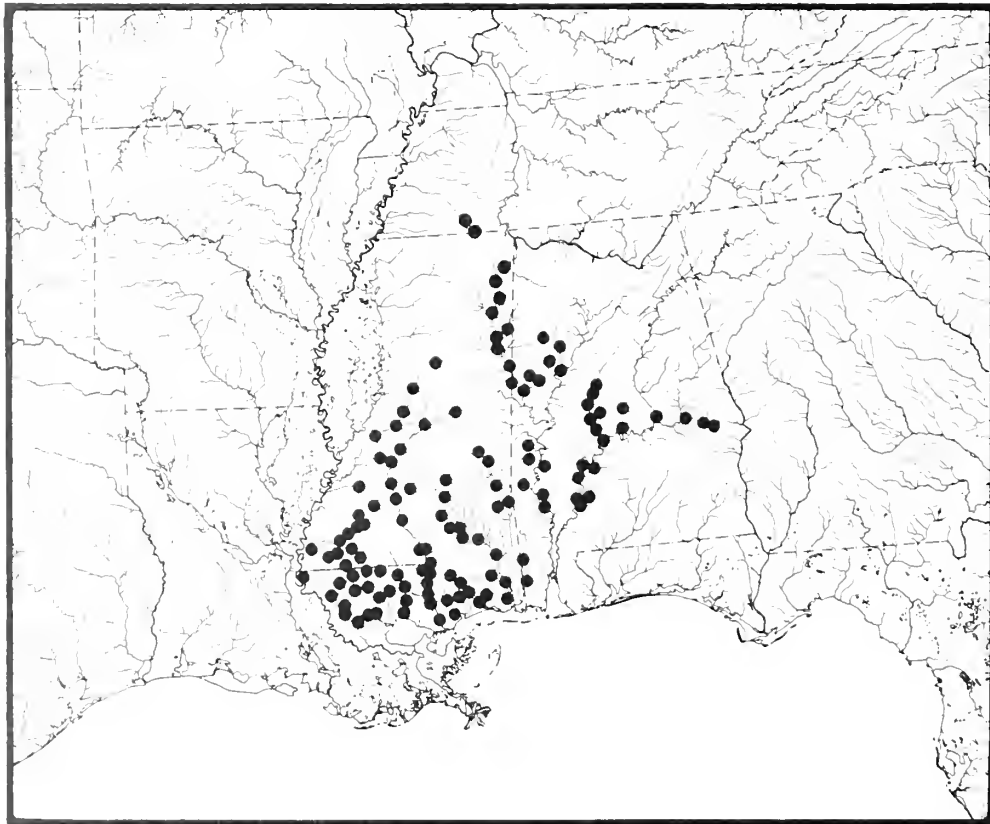
Order Perciformes
Family Percidae

TYPE LOCALITY: Natalbany River, near Tickfaw, LA (Jordan 1877. Bull. U. S. Natl. Mus. 10:5-68).

SYSTEMATICS: Subgenus *Ammocrypta*. Member of *A. beani* group, with *A. bifascia* and *A. clara*. Williams (1975. Bull. Ala. Mus. Nat. Hist. 1:1-56) reviewed systematics of this and other species of the subgenus.



MS: Madison Co., Big Black River, 43 mm SL (Williams 1975).



Map modified from Williams 1975

DISTRIBUTION AND HABITAT: Hatchie River (tributary of Mississippi River, southwest TN) south to Mississippi River tributaries in south-central MS and Lake Pontchartrain, LA, and east to Mobile drainage. Occurs in habitats ranging from small streams 3-5 m wide, to rivers with moderate current. Prefers shifting sand substrate. Often rather common in preferred habitat. (Williams 1975).

ADULT SIZE: 35-52 mm SL.

BIOLOGY: Williams (1975) collected gravid females between early June and late August. Egg counts ranged from 52-71 in females measuring 39-50 mm SL. Spawning probably occurs during late June and early July (Williams 1975).

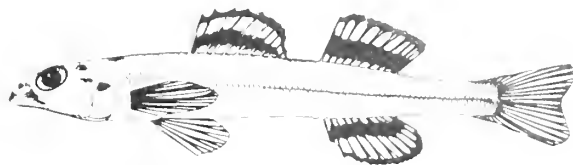
Compiler: J. R. Stauffer, Jr. October 1978.

Ammocrypta bifascia Williams
Florida sand darter

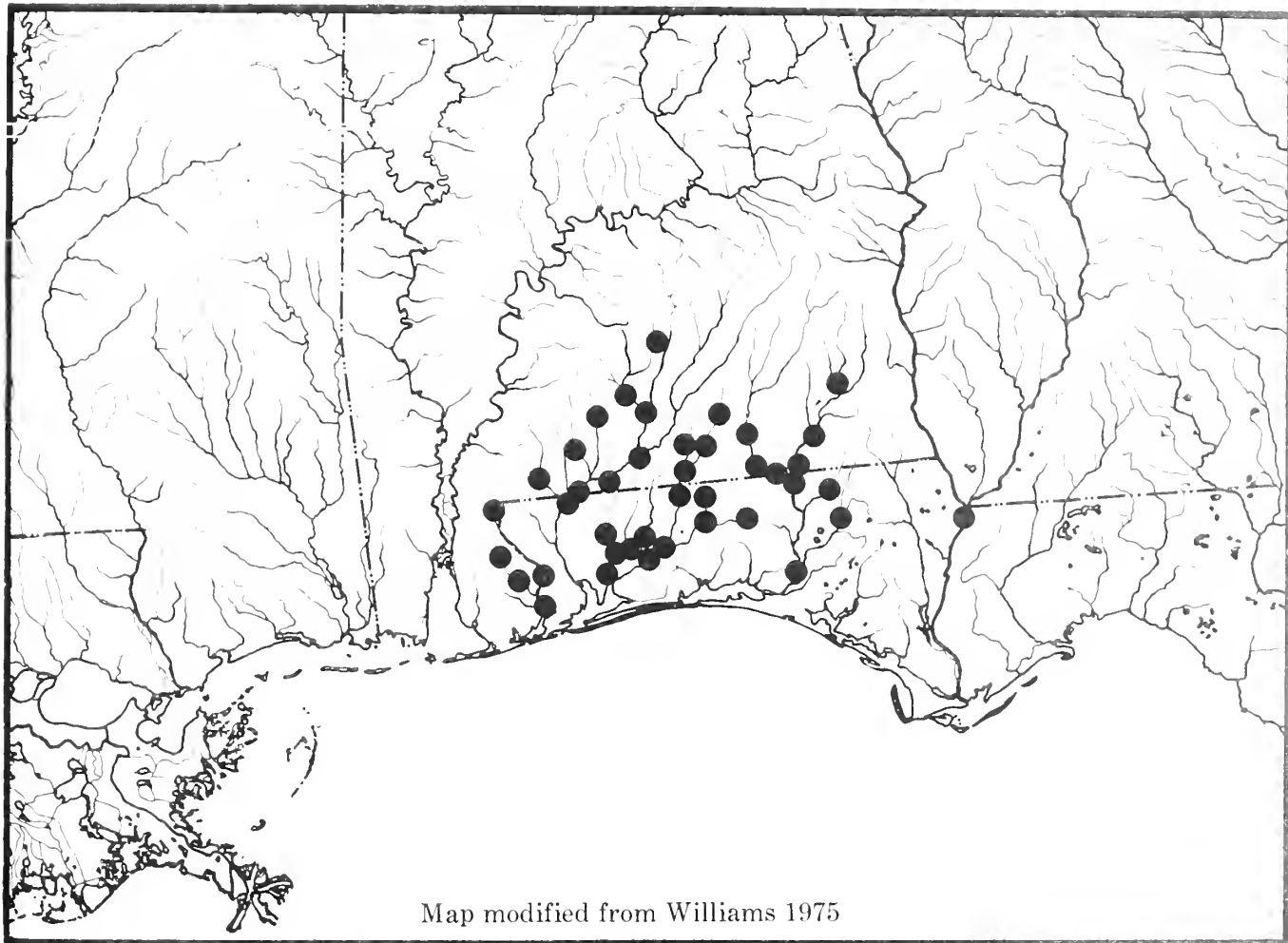
Order Perciformes
Family Percidae

TYPE LOCALITY: Choctawhatchee River, 1.5 km w of Pittman, on State hwy. 2, Holmes Co., FL (Williams 1975. Bull. Ala. Mus. Nat. Hist. 1:1-56).

SYSTEMATICS: Subgenus *Ammocrypta*. Member of *A. beani* group, with *A. clara*. Williams (1975) reviewed this and other species of subgenus. Formerly regarded as *A. beani*.



FL: Holmes Co.,
Choctawhatchee River, male,
61 mm SL (Williams 1975).



Map modified from Williams 1975

DISTRIBUTION AND HABITAT: Southern AL and western FL from Perdido River drainage east to Choctawhatchee (only known from Choctawhatchee River and tributaries, not from other independent tributaries of Choctawhatchee Bay). Two specimens from Apalachicola River below Jim Woodruff Dam, a well-collected basin, which raises possibility of human introduction (Starnes and Starnes 1979. Fla. Sci. 42:61-62). Most frequently found at depths of 0.4-1.2 m in moderate to large streams with shifting sand bottom and moderate to swift current. Often fairly common in preferred habitat.

ADULT SIZE: 64 mm SL maximum.

BIOLOGY: Probably spawns late May to early June. Eggs number 49-69 in females measuring 42-53 mm SL (Williams 1975).

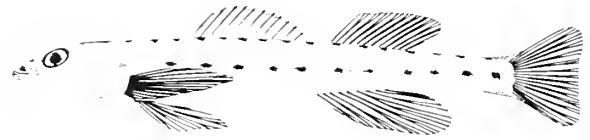
Compilers: J. R. Stauffer, Jr., C. H. Hocutt,
and C. R. Gilbert. October 1978.

Ammocrypta clara Jordan and Meek
Western sand darter

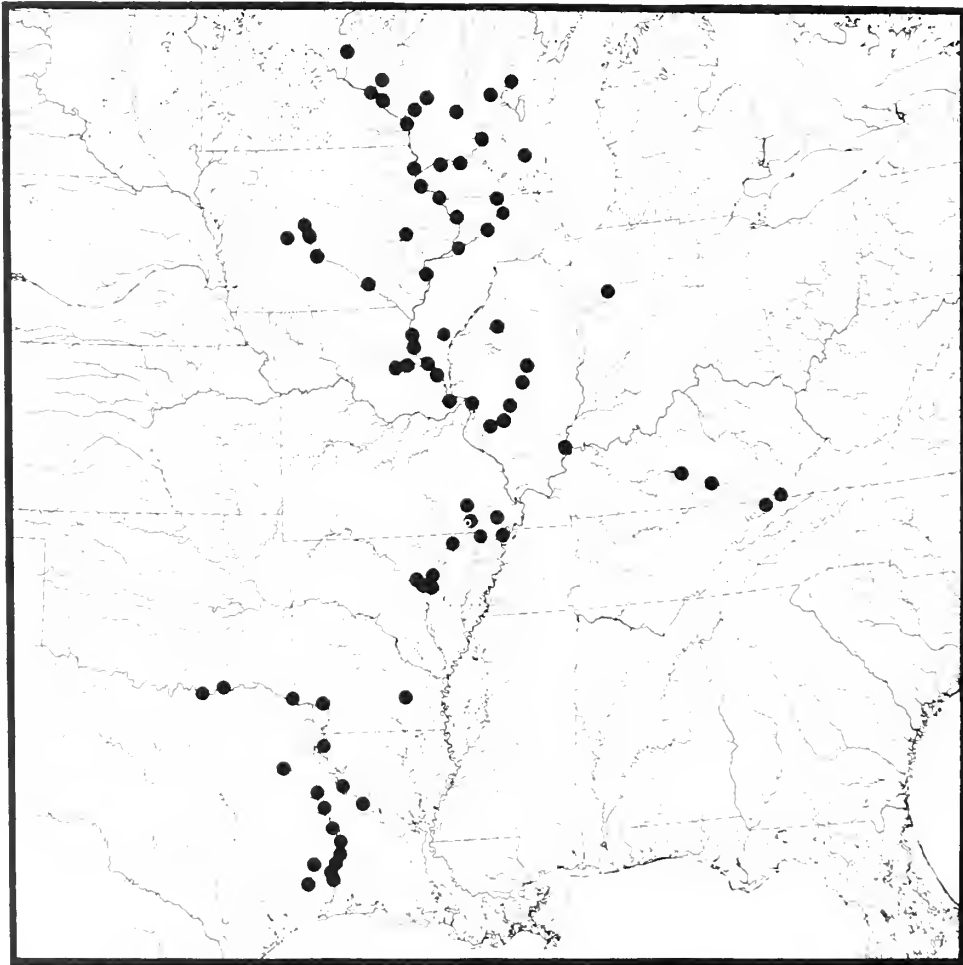
Order Perciformes
Family Percidae

TYPE LOCALITY: Des Moines River, Ottumwa, IA (Jordan and Meek 1885. Proc. U.S. Natl. Mus. 8:1-17).

SYSTEMATICS: Subgenus *Ammocrypta*. Member of *A. beani* group. Williams (1975. Bull. Ala. Mus. Nat. Hist. 1:1-56) reviewed subgenus.



WI: Waupaca Co., Waupaca River, male, 50 mm SL (Williams 1975).



Map modified from Williams 1975

DISTRIBUTION AND HABITAT: Neches and Sabine drainages of eastern TX, north through Mississippi Valley to MN and WI. Also in Green and Cumberland river drainages, KY, (pre-1930 records) and Powell River, upper Tennessee River drainage (1976 collection).

BIOLOGY: Spawns July and early August, based on breeding tubercles and ovary examination. Spawning may be prolonged to late August. Females usually more abundant than males in collections. Williams (1975) presented general summary of ecology and behavior of species of subgenus *Ammocrypta*.

ADULT SIZE: 35-59 mm SL.

Compiler: J. R. Stauffer, Jr. June 1978.

Ammocrypta meridiana Williams
Southern sand darter

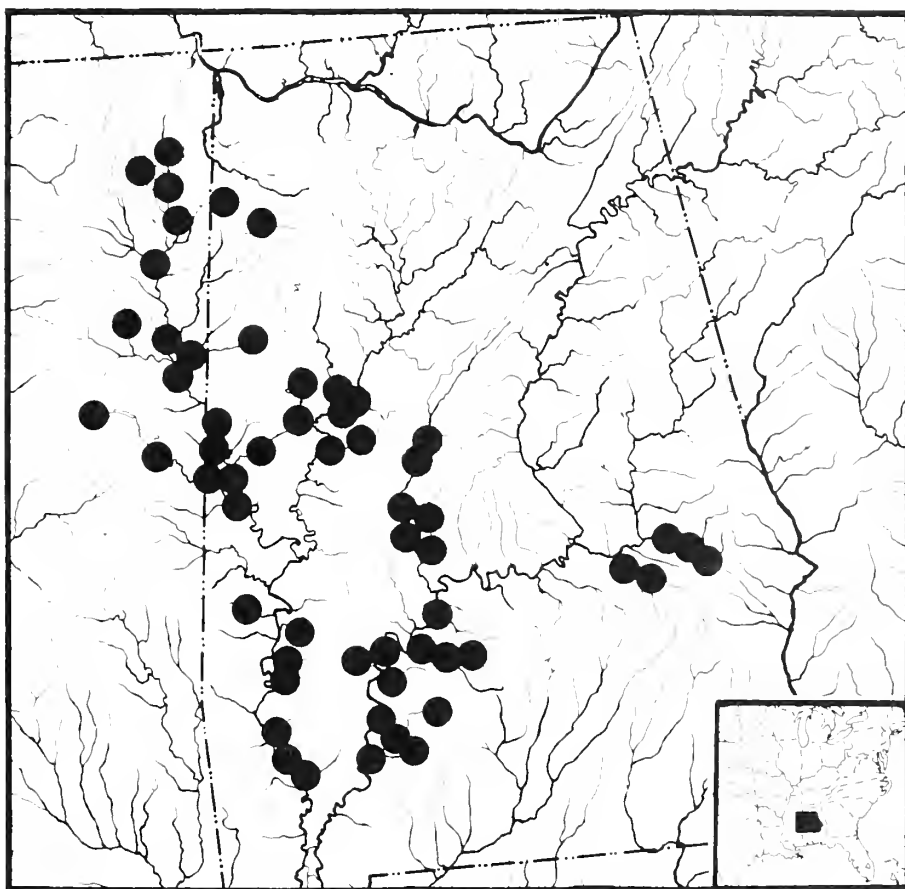
Order Perciformes
Family Percidae

TYPE LOCALITY: Cedar Creek, 12 km ssw of Sardis, Dallas Co., AL, on state hwy. 41 (Williams 1975. Bull. Ala. Mus. Nat. Hist. 1:1-56).

SYSTEMATICS: Subgenus *Ammocrypta*. Most closely related to *A. pellucida* (Williams 1975).



AL: Wilcox Co., Cedar Creek, male, 50 mm SL (Williams 1975).



Map modified from Williams 1975

DISTRIBUTION AND HABITAT: Endemic to Mobile Bay drainage. Throughout Alabama system, upper and lower Tombigbee system, and Coastal Plain province of Warrior, Cahaba, and Tallapoosa systems. In moderate to large creeks and rivers with moderate current, over clean, sandy substrate, and collected at depths to 1.5 m (Williams 1975).

BIOLOGY: Based on tubercle development and ovary examination, spawning apparently occurs between first week of June and end of July. Williams (1975) presented general summary of ecology and behavior of species of subgenus *Ammocrypta*.

ADULT SIZE: 46-58 mm SL.

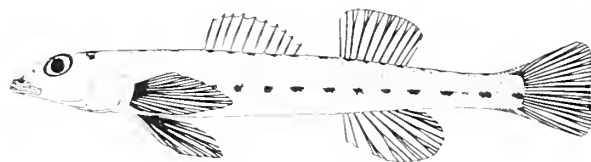
Compiler: C. H. Hocutt, June 1978.

Ammocrypta pellucida (Agassiz)
Eastern sand darter

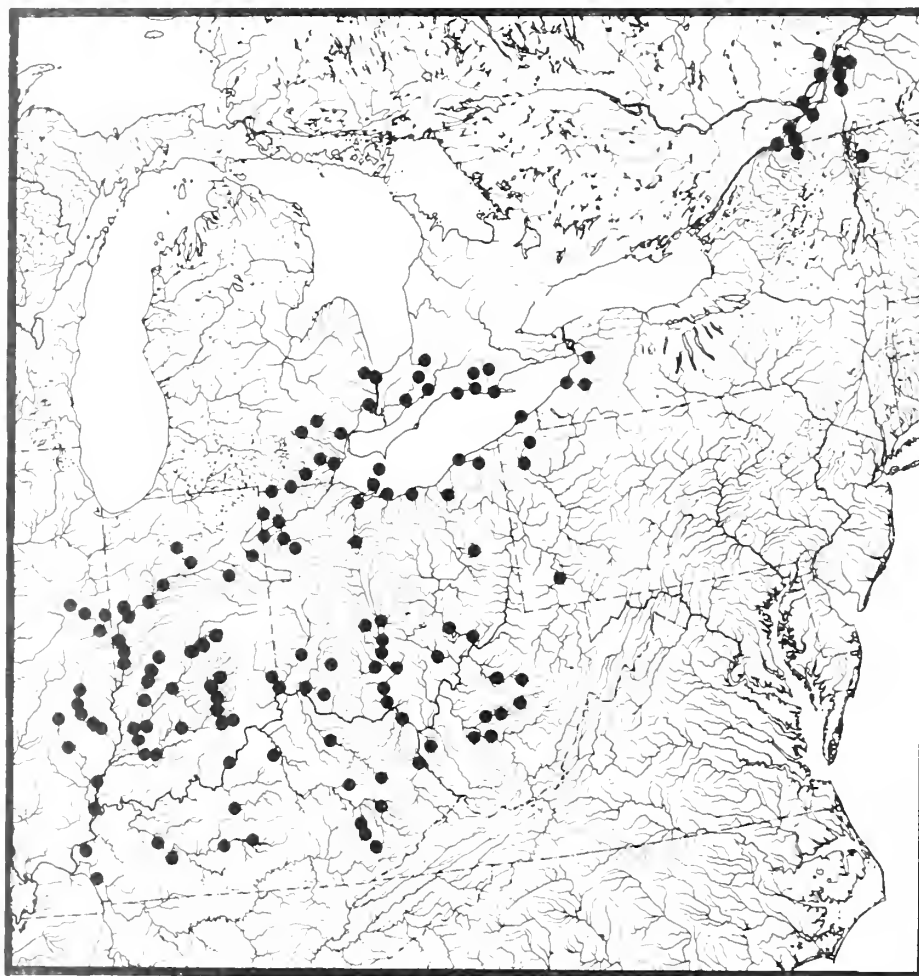
Order Perciformes
Family Percidae

TYPE LOCALITY: (Lectotype) Black River below falls at Elyria, OH (Agassiz in Putman 1863. Bull. Mus. Comp. Zool. 1:1-16).

SYSTEMATICS: Subgenus *Ammocrypta*. Most closely related to *A. meridiana* and *A. vivax*. Williams (1975. Bull. Ala. Mus. Nat. Hist. 1:1-56) reviewed subgenus.



OH: Morgan Co., Muskingum River, male, 51 mm SL (Williams 1975).



Map modified from Williams 1975

DISTRIBUTION AND HABITAT: Throughout most of Ohio River basin south to western KY, southern end of Lake Huron, lakes St. Clair, and Erie; with disjunct population in middle St. Lawrence-Lake Champlain drainage. Inhabits lotic habitats ranging from small creeks to large rivers, and wave-protected areas of lentic habitats. Usually confined to shifting sand substrate; at various times may be found over wide variety of substrates including mud and clay mixed with sand, silt, gravel, and sand. Seldom common. Has decreased markedly in both abundance and range in recent years (Williams 1975).

ADULT SIZE: 47-52 mm SL.

BIOLOGY: Feeds primarily on *Chironomus* and other midge larvae. Spawns from mid-May through August. Williams (1975) presented general summary of ecology and behavior of species of subgenus *Ammocrypta*.

Compiler: C. H. Hocutt. June 1978.

Ammocrypta vivax Hay
Scaly sand darter

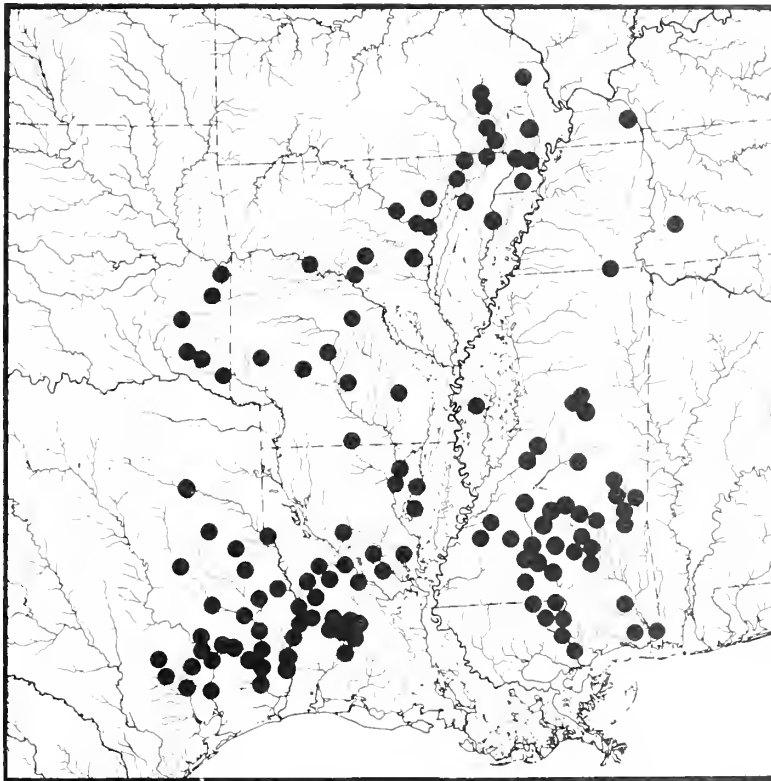
Order Perciformes
Family Percidae

TYPE LOCALITY: Pearl River, Jackson, MS (Hay 1881. Proc. U.S. Natl. Mus. 3:488-515).

SYSTEMATICS: Subgenus *Ammocrypta*. Member of *A. pellucida* group (Williams 1975. Bull. Ala. Mus. Nat. Hist. 1:1-56).



LA: Vernon Parish, Bayou Anacoco, male 56 mm SL (Williams 1975).



Map modified from Williams 1975

DISTRIBUTION AND HABITAT: Centered in central portion of Mississippi embayment. West of Mississippi River known from Calcasieu, Sabine, Neches, Trinity, San Jacinto, Red, Ouachita, Arkansas, White, and St. Francis drainages. In eastern tributaries inhabits Hatchie, Yazoo, Big Black, Bayou Pierre, Pearl, Biloxi Bay, and Pascagoula Bay drainages. Generally a Coastal Plain inhabitant (Williams 1975).

ADULT SIZE: 48-61 mm SL.

BIOLOGY: Tuberculate males known from mid-April through mid-August. Williams (1975) presented general summary of ecology and behavior of species of subgenus *Ammocrypta*.

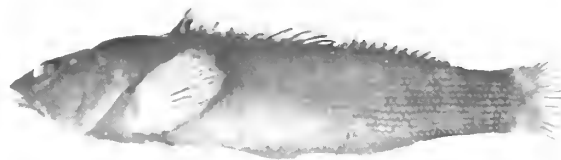
Compilers: J. R. Stauffer and C. H. Hocutt. June 1978.

Etheostoma acuticeps Bailey
Sharphead darter

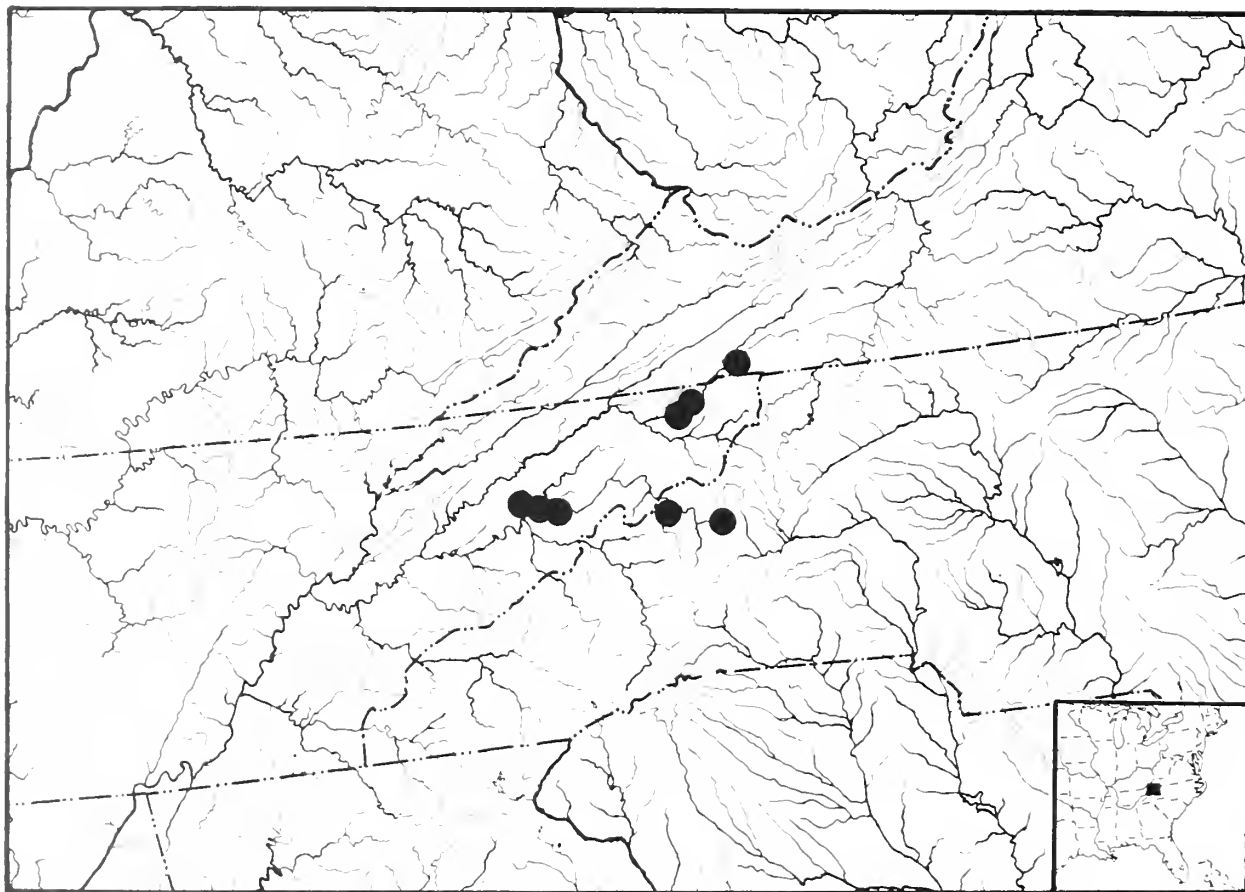
Order Perciformes
Family Percidae

TYPE LOCALITY: South Fork Holston River, 0.8 km above South Holston Dam, Sullivan Co., TN (Bailey 1959. Occas. Pap. Mus. Zool. Univ. Mich. 603:1-10).

SYSTEMATICS: Subgenus *Nothonotus*. Probably most closely related to *E. maculatum* (Zorach 1972. Copeia:427-47). Jenkins and Burkhead (1975. Copeia:731-40) redescribed species and provided additional meristic data.



TN: Greene-Cocke Co., Nolichucky River, 68 mm SL (R. T. Bryant, Jr.).



DISTRIBUTION AND HABITAT: Restricted to South Fork Holston and Nolichucky (Toe) river systems of TN, VA, and NC, upper Tennessee drainage. Extirpated from Holston system in TN and Toe system in NC. Persists in South Fork Holston River just above South Holston Reservoir, Washington Co., VA, in Cane River, Yancey Co., NC, and in lower Nolichucky River between Davy Crockett and Douglas reservoirs. In swift, shallow to moderately deep, gravel and cobble riffles. Common in lower Nolichucky River; extremely rare elsewhere.

ADULT SIZE: 40-70 mm SL.

BIOLOGY: Preliminary studies (Bryant pers. comm.) indicate spawning from late spring through summer, and that female buries eggs in sand in riffle areas. Spawns when two and three years of age and feeds on benthic insects (Jenkins and Burkhead 1975).

Compiler: D. A. Etnier. June 1978.

Etheostoma aquali Williams and
Etnier
Coppercheek darter

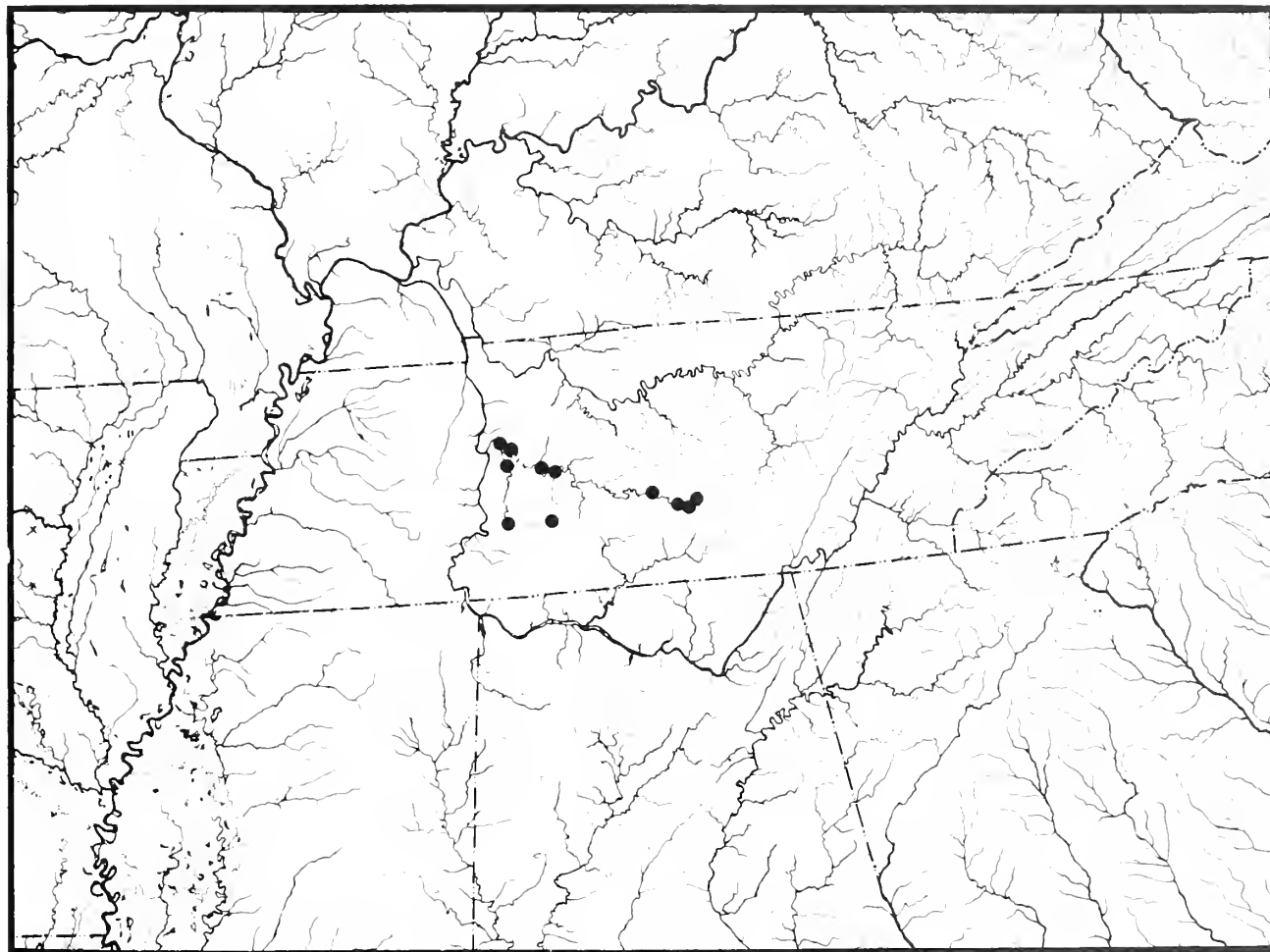
Order Perciformes
Family Percidae

TYPE LOCALITY: Flat Creek, tributary of Duck River at TN hwy. 64, Bedford Co., TN (Williams and Etnier 1978. Proc. Biol. Soc. Wash. 91:463-71.)

SYSTEMATICS: Subgenus *Nothonotus*. Member of *E. maculatum* species group (Williams and Etnier 1978).



TN: Bedford Co., Flat Creek, male, 64 mm SL (Williams and Etnier 1978).



DISTRIBUTION AND HABITAT: Endemic to Duck and Buffalo rivers in central TN. Primarily an inhabitant of main channel and lower portions of larger tributaries. Appears to prefer shoal areas (0.3-1 m deep) with moderate to swift current. Preferred substrate is mixture of gravel and cobbles interspersed with large, unconsolidated rocks, around which it is most often collected (Williams and Etnier 1978).

ADULT SIZE: 45-67 mm SL.

BIOLOGY: No information available. Presumably similar to *E. maculatum*.

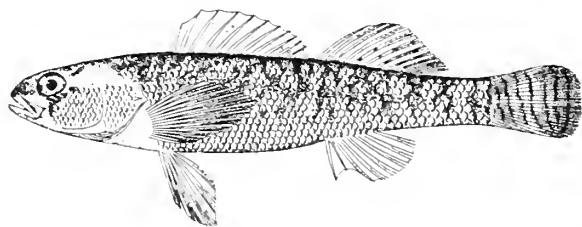
Compilers: J. R. Stauffer, Jr. October 1978.

Etheostoma asprigene (Forbes)
Mud darter

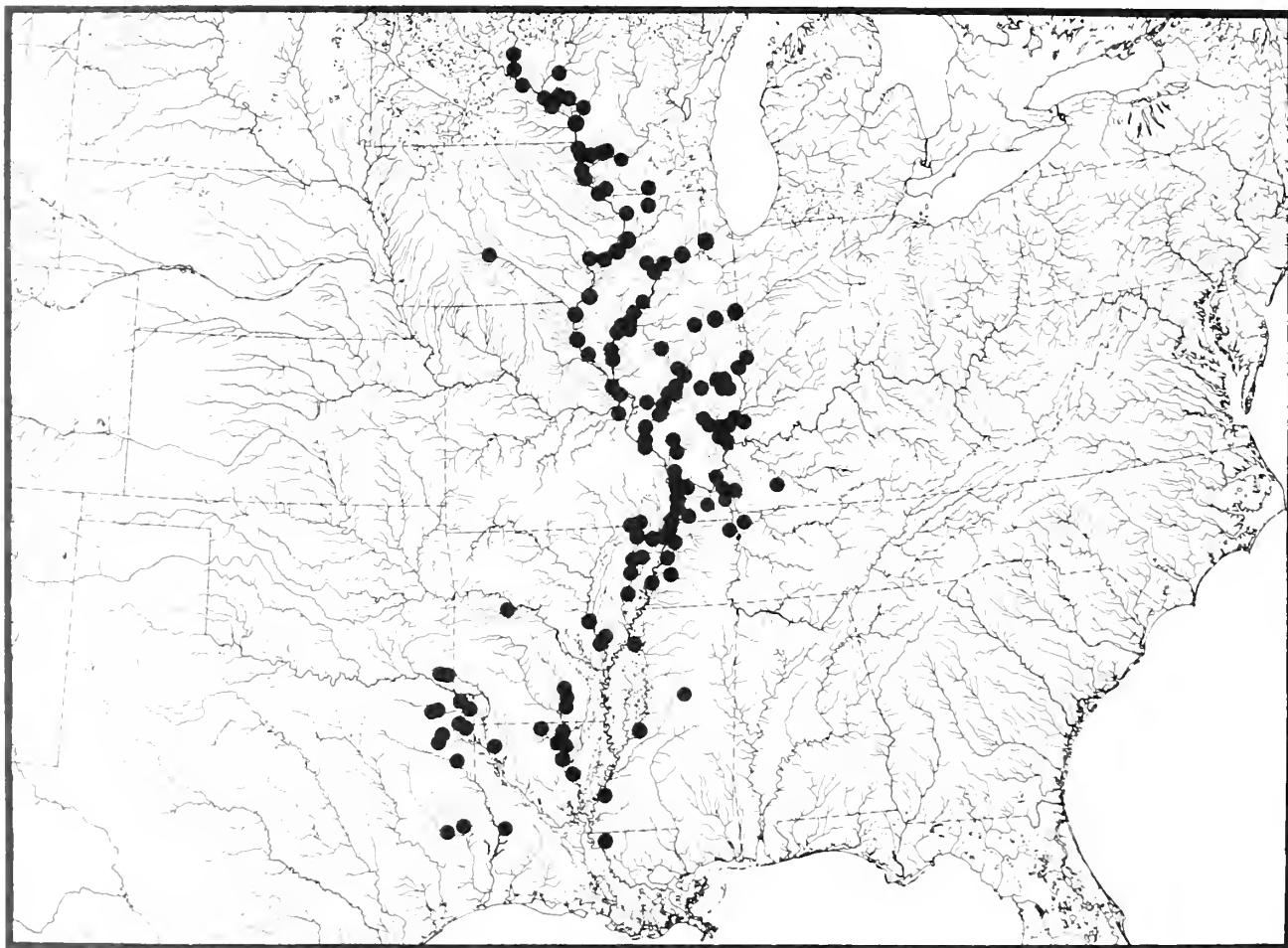
Order Perciformes
Family Percidae

TYPE LOCALITY: Small creek near Pekin, IL (Forbes in Jordan 1878. Bull. Ill. State Lab. Nat. Hist. 1:32-70).

SYSTEMATICS: Subgenus *Oligocephalus*. Closest relatives may be *E. ditrema*, *E. nuchale*, and *E. swaini* which have been placed in the *E. asprigene* complex by Ramsey and Suttkus (1965, Tulane Stud. Zool. 12:65-77). Group may also include *E. hopkinsi* and *E. fricksium*. Very similar in appearance to *E. collettei*, but not regarded as close relative by Birdsong and Knapp (1969, Tulane Stud. Zool. 15:106-12).



IL: Lake Peoria, ca. 42 mm SL
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Primarily restricted to backwaters of larger rivers of Mississippi Valley and west to Neches drainage of east TX. Inhabits areas of sluggish to moderate current with substrates of mud, sand, and detritus. Persists in reservoirs in mouths of tributaries. Many specimens from eastern tributaries of Mississippi River, TN and MS, previously identified as *E. asprigene* represent *E. swaini*. Sympatric and occasionally syntopic with very similar appearing *E. collettei* in AR and LA.

ADULT SIZE: 45-55 mm SL, 65 mm TL maximum.

BIOLOGY: Spawns April to May (Becker, pers. comm.).

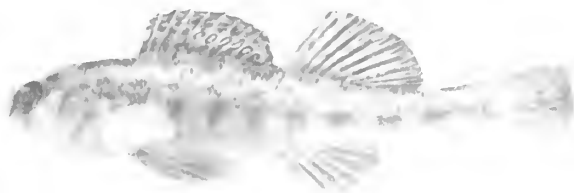
Compiler: W. C. Starnes. May 1978.

Etheostoma atripinne (Jordan)
Cumberland snubnose darter

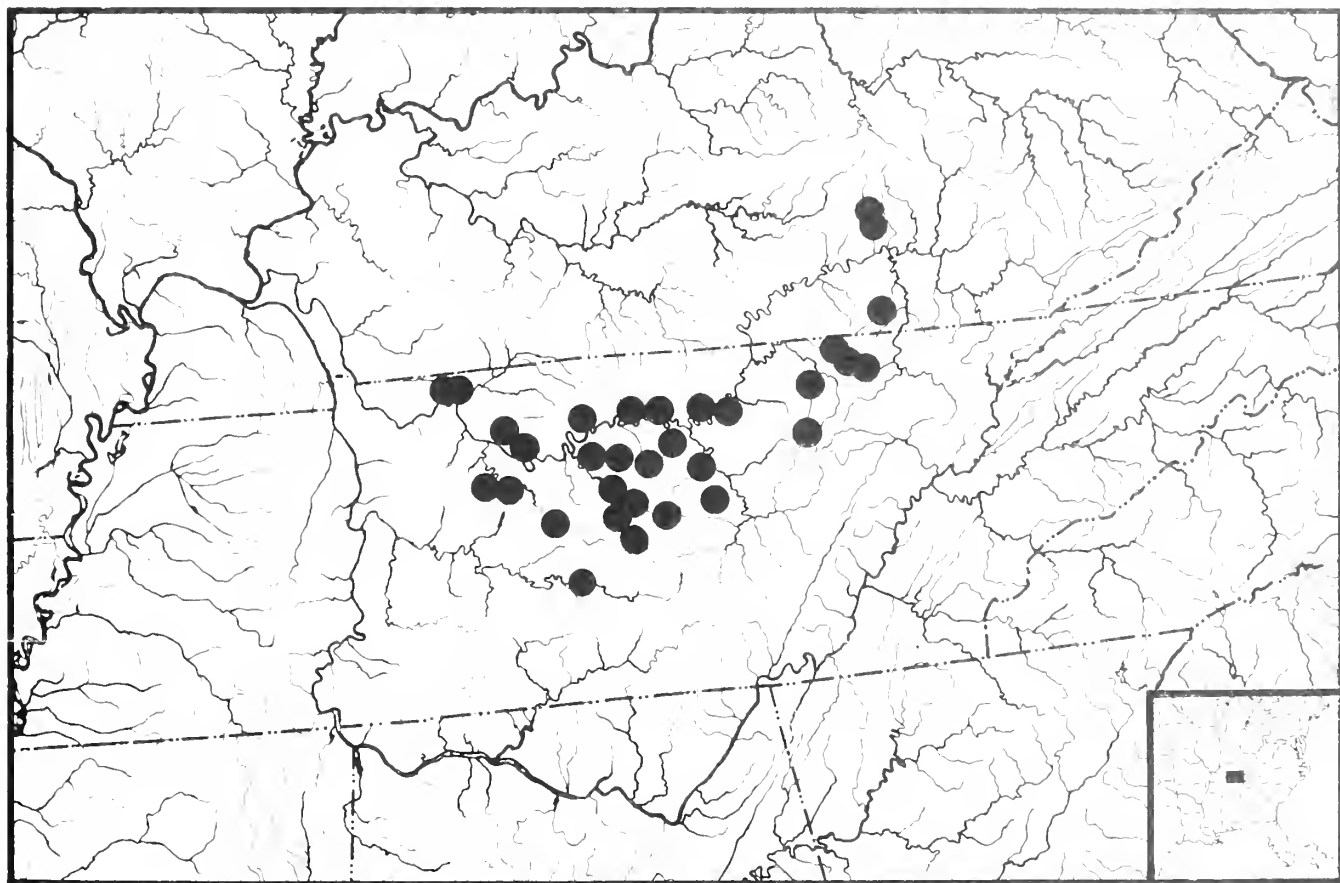
Order Perciformes
Family Percidae

TYPE LOCALITY: Tributary to Cumberland River near Nashville, TN (Jordan 1877. U.S. Natl. Mus. Bull. 10:1-68).

SYSTEMATICS: Subgenus *Ulocentra*. Most closely related to and probably conspecific with *E. simoterum* (see comments under *E. simoterum*). Only *Ulocentra* in eastern portion of its range, but is sympatric with an undescribed species that lacks a frenum (*E. atripinne* has distinct frenum) in western portion of its range.



TN: Marshall Co., 43 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Until details of the relationship between *E. atripinne* and *E. simoterum* are clarified, the former is considered a middle Cumberland River drainage endemic, TN and KY. Replaced by *E. etnieri* in most of Caney Fork system and by another undescribed species in upper Cumberland drainage. Specimens of an extirpated population from Little South Fork of Cumberland River represent former upstream limit. Common in small to medium streams in gravel riffle areas.

ADULT SIZE: 40-60 mm SL.

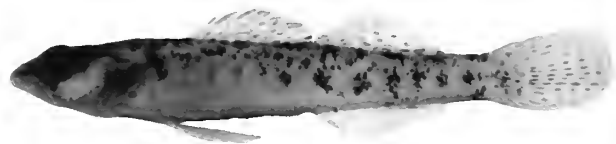
BIOLOGY: Unstudied.

Compiler: D. A. Etnier, June 1978.

Etheostoma barbouri Kuehne and
Small
Teardrop darter

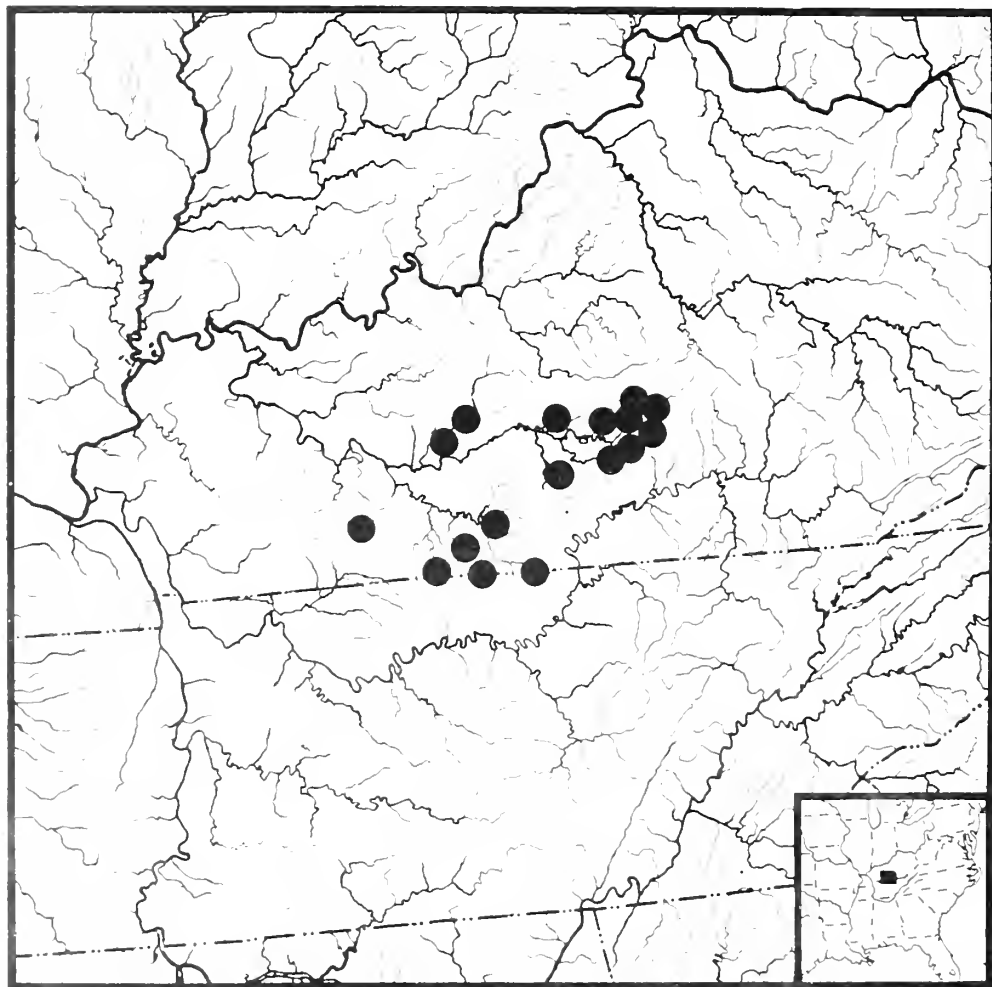
Order Perciformes
Family Percidae

TYPE LOCALITY: Brush Creek, tributary to Green River, 4.3 km n of Liberty, Casey Co., KY, off state route 49 (Kuehne and Small 1971, Copeia:18-26).



SYSTEMATICS: Subgenus *Catonotus*. Member of "barcheek darter" group, which includes *E. virgatum*, *E. obeyense*, *E. smithi*, and *E. striatulum*.

KY: Casey Co., Brush Creek, 30 mm SL (R. T. Bryant, Jr.).



Map from Kuehne and Small 1971

DISTRIBUTION AND HABITAT: Endemic to upper Green River drainage, TN and KY, where moderately common in preferred habitat. Most common in small streams, where usually found in pools free of debris or against sandy and rocky shores at depth of less than 0.6 m. Uncommon in riffles.

ADULT SIZE: 33-50 mm TL, 63 mm SL maximum.

BIOLOGY: No information available.

Compiler: J. R. Stauffer, Jr. October 1978.

Etheostoma bellum Zorach
Orangefin darter

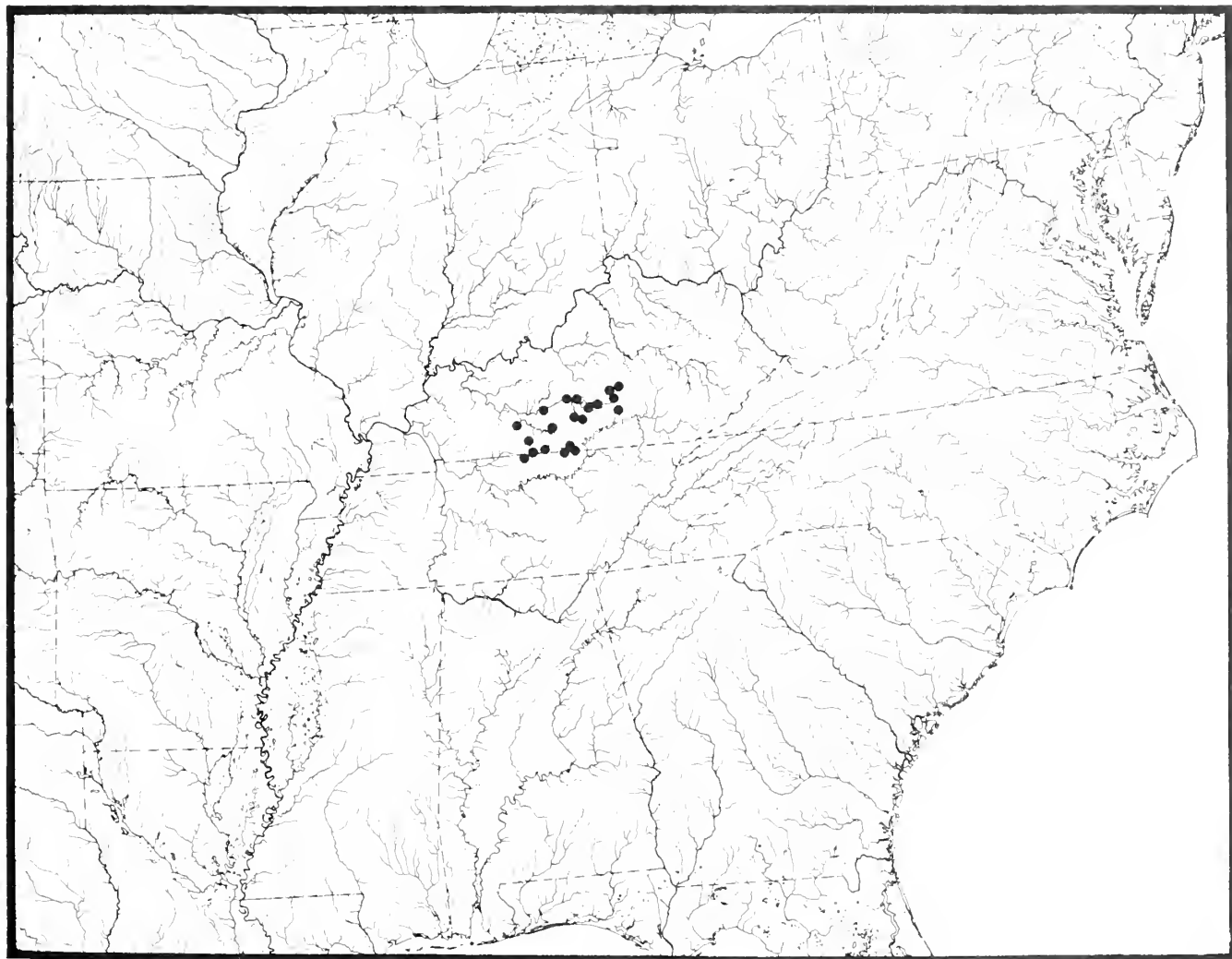
Order Perciformes
Family Percidae

TYPE LOCALITY: White Oak Creek, at Bridge between White Oak and Galen, 1.9 km nw of Galen on secondary road, Macon Co., TN (Zorach 1968. Copeia:474-82).

SYSTEMATICS: Subgenus *Nothonotus*. Closest affinities appear to be with *E. rufilineatum* (Zorach 1968), in species complex that also includes *E. camurum* and *E. chlorobranchium* (Zorach 1972. Copeia:427-47). Body form superficially more similar to last two species and, prior to description, was considered a population of *E. camurum*.



TN: Barren system, 52 mm SL
(R. T. Bryant, Jr.).



DISTRIBUTION AND HABITAT: Restricted to Barren River system, TN and KY, and upper Green River system, KY, above confluence with Barren River. Occupies clean, clear streams of small to medium size; over gravel riffles 8-15 cm in depth (Zorach 1968). Usually in streams smaller than those occupied by *E. camurum*.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Little known. Zorach (1968) presented information on sexual dimorphism, coloration, and species associates.

Compiler: C. H. Hocutt. September 1978.

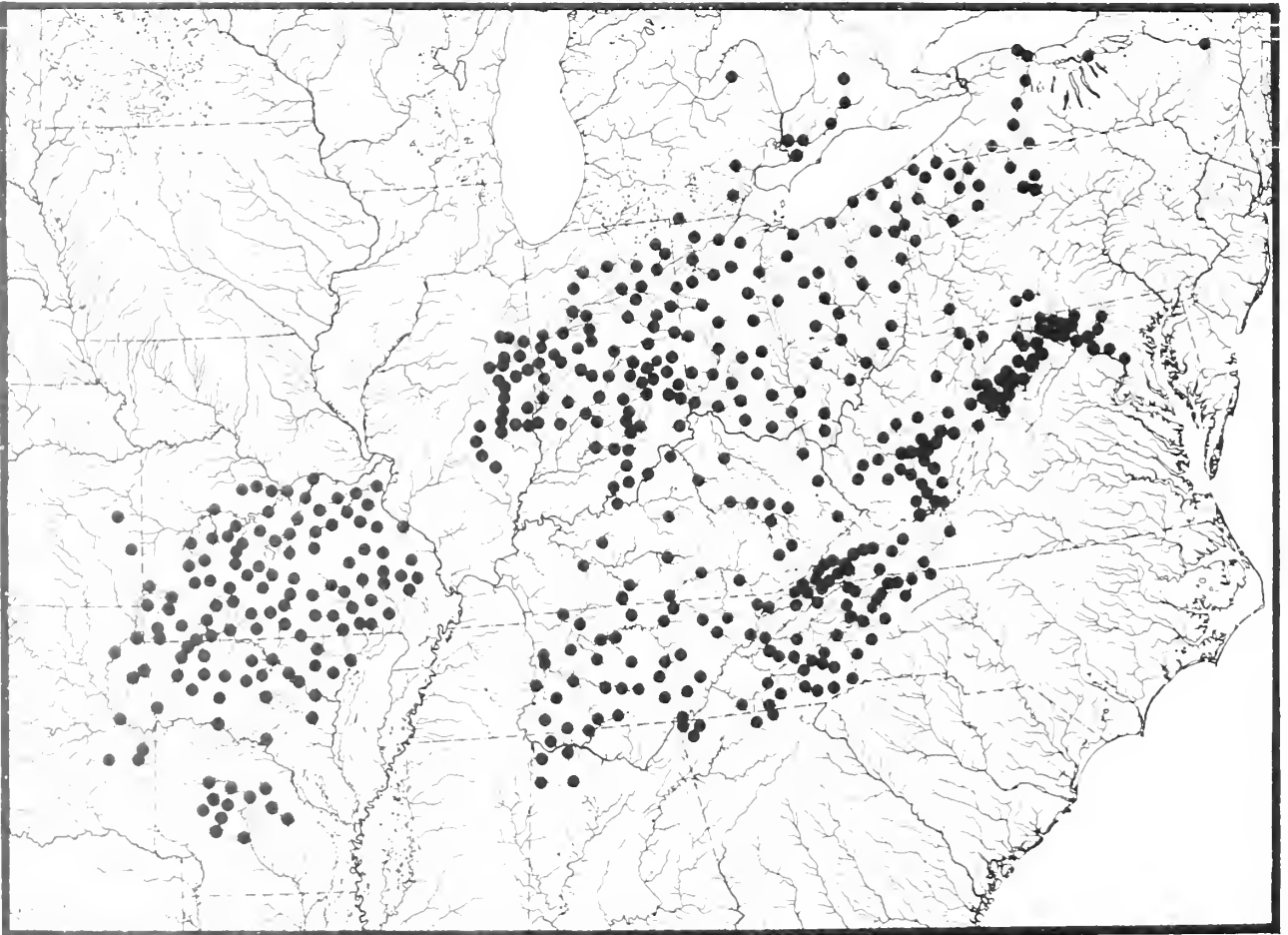
Etheostoma blennioides Rafinesque
Greenside darter

Order Perciformes
Family Percidae



MD: Washington Co., Taylors
landing, 55 mm SL (NCSM).

TYPE LOCALITY: Falls of the Ohio below Louisville, KY (Rafinesque 1819, J. Phys. Chim. Hist. Nat. Arts 88:417-29).
SYSTEMATICS: Subgenus *Etheostoma*. Placed by Richards (1966, Copeia:823-38) with *E. zonale*, *E. rupestre*, and *E. histrio*; called the *blennioides* group. Collette (1965, Proc. U. S. Natl. Mus. 117:567-614) had arranged *E. blennioides* with other tuberculate members of subgenus into *inscriptum* group, which excluded the former three species. Miller (1968, Copeia:1-40) recognized four subspecies, including *E. gutselli* (previously considered a species).



DISTRIBUTION AND HABITAT: Extensive distribution in Ohio basin, south-western Great Lakes, Potomac drainage and western tributaries of Susquehanna River; Tennessee drainage, western tributaries of Mississippi River in MO and AR, Red River drainage. Distributional and zoogeographical discussion in Miller (1968), Schwartz (1965, Copeia:285-90) and Denoncourt et al. (1977, Ohio J. Sci. 77:38-42). Although found in variety of habitats, is more prevalent in rivers and streams of moderate to fast current and low turbidity among rubble and small boulders.

ADULT SIZE: ca. 65-75 mm SL, but reaches very large size in some populations (138 mm SL).

BIOLOGY: Fahy (1954, J. Elisha Mitchell Sci. Soc. 70:139-205) studied life history in NY. Aspects of this and other works partly summarized in Miller (1968). Sexual dimorphism pronounced, spawning occurring at above 13°C in spring. Longevity to three or four years. Consumes benthic and rheophilic organisms.

Compiler: R. F. Denoncourt, May 1979.

Etheostoma blennioides Gilbert and Swain
Blenny darter

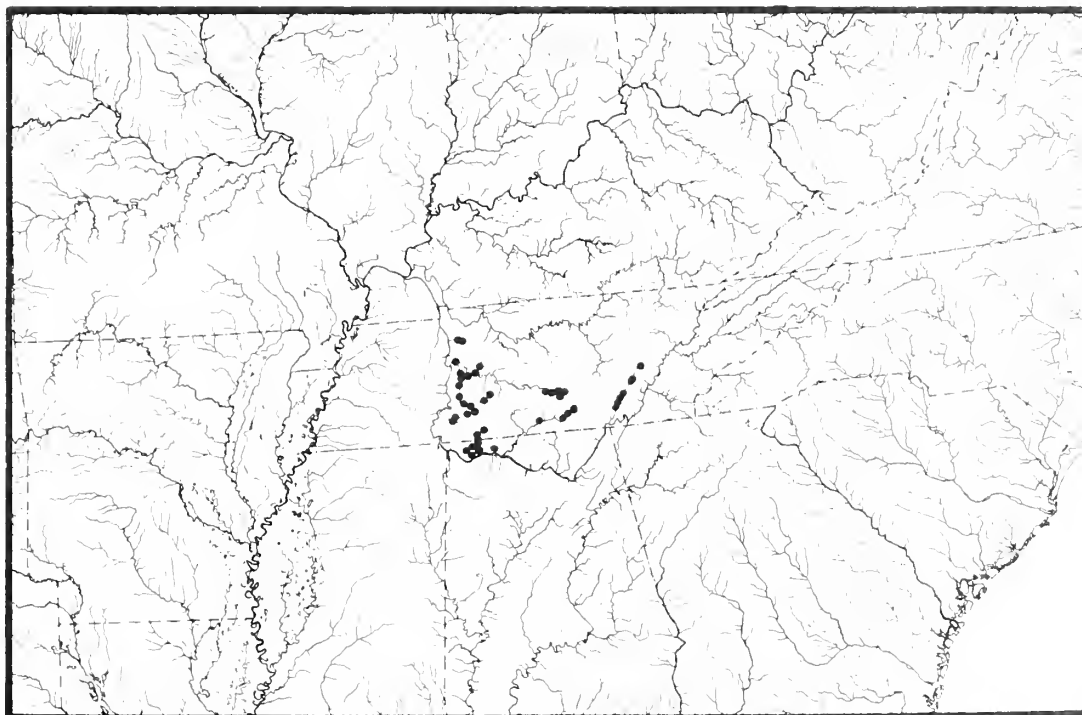
Order Perciformes
Family Percidae

TYPE LOCALITY: Cox's Creek, near Florence, Lauderdale Co., AL (Gilbert and Swain *in* Gilbert 1887. Proc. U.S. Natl. Mus. 10:47-64).

SYSTEMATICS: Subgenus *Etheostoma*. Description and discussion by Hubbs and Black (1940. Occas. Pap. Mus. Zool. Univ. Mich. 416:1-30; Burr 1979. Copeia: 191-203). Based on tubercle pattern and other morphological features, closest relative probably *E. swainsonae* (Thompson 1973. ASB Bull. 20:87). Distinct morphotype from Sequatchie River, TN, described as *E. b. sequatchiense* by Burr (1979).



TN: Bedford Co., Thompson Creek, male, 60 mm SL
(B.M. Burr)



DISTRIBUTION AND HABITAT: Restricted to tributaries of Tennessee River drainage in TN and AL. *Etheostoma b. sequatchiense* occurs only in Sequatchie River, TN, with intergrades in Elk River, TN, and Second Creek, AL. Most frequently in large to medium-sized streams with clear, cool water, in deep, fast riffles over gravel or rubble bottom. Occasionally in long, shallow riffles of small creeks. Common in some streams.

ADULT SIZE: 45-69 mm SL.

BIOLOGY: Poorly known. Information on age, growth, fecundity, and food habits summarized by Burr (1979).

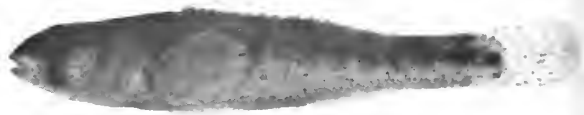
Compiler: B. M. Burr. March 1980.

Etheostoma boschungi Wall and
Williams
Slackwater darter

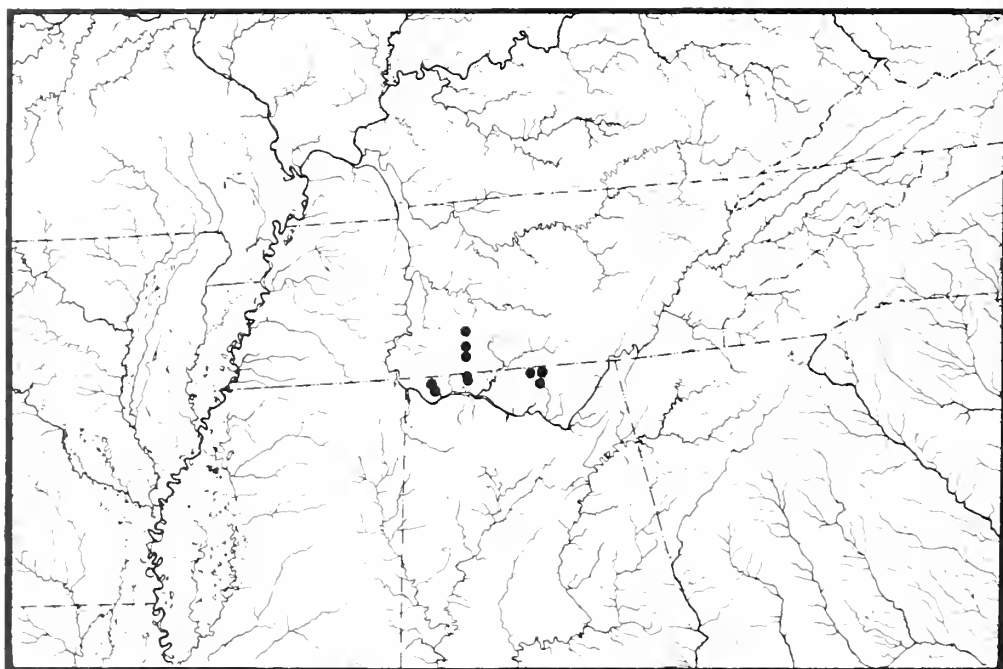
Order Perciformes
Family Percidae

TYPE LOCALITY: Lindsey Creek, T2S, R12W, Sec. 3, Cypress Creek watershed, Lauderdale Co., AL (Wall and Williams 1974. Tulane Stud. Zool. Bot. 18:172-82).

SYSTEMATICS: Subgenus *Oligocephalus*. Closely allied with *E. craigini*, *E. pallididorsum*, *E. punctulatum*, and *E. trisella*.



AL: Lauderdale Co., tributary to North Fork Creek, 39 mm SL (R. T. Bryant, Jr.).



DISTRIBUTION AND HABITAT: Five disjunct localities in south bend of Tennessee River (Cypress Creek watershed, Lauderdale Co., AL, and Wayne Co., TN; Swan Creek, Limestone Co., AL; headwaters of Shoal Creek, Lawrence Co., TN; and Flint River, Madison Co., AL), and headwaters of Buffalo River, Lawrence Co., TN. Two distinctly different but adjacent habitats. Non-breeding habitat is typically sluggish areas of small or medium-sized streams. Often in undercut banks or accumulations of old leaf litter or detritus. Will traverse swifter streams during migrations to breeding habitat, which is very shallow seepage water in open pastures and wooded areas. Typical breeding habitat characterized by

presence of *Juncus* and *Eleocharis* in clear, moving seepage or spring water; dry during summer.

ADULT SIZE: 40-51 mm SL, 62 mm SL maximum.

BIOLOGY: Winter rains swell creeks enough to "lift" adults into breeding habitat. Spawns late February to early April and whenever water temperatures reach or exceed 14°C. Eggs laid in *Juncus*, two or three at a time. After they reach ca. 12 mm SL larvae return to adjacent streams. Feeds primarily on insects and isopods.

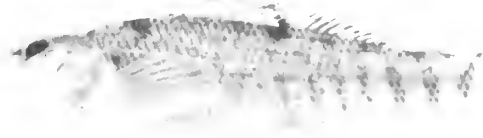
Compiler: H. T. Boschung, July 1979.

Etheostoma caeruleum Storer
Rainbow darter

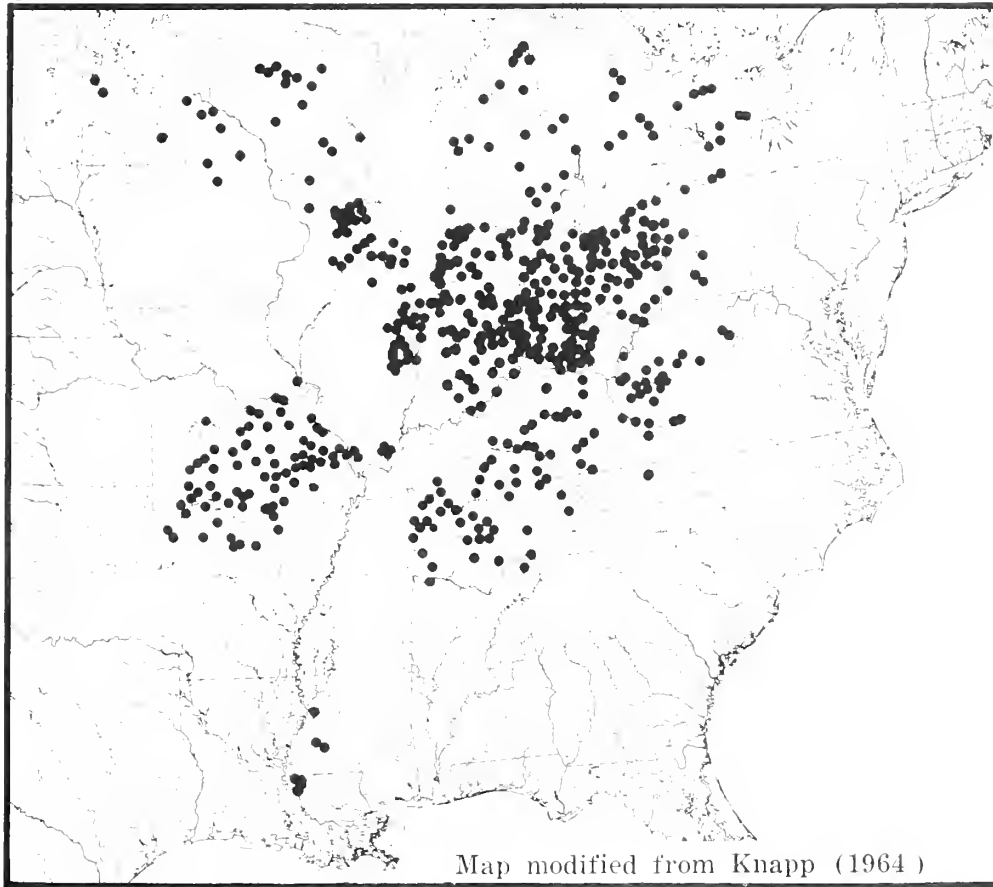
Order Perciformes
Family Percidae

TYPE LOCALITY: Fox River, IL (Storer 1845. Proc. Boston Soc. Nat. Hist. 2:47-48).

SYSTEMATICS: Subgenus *Oligocephalus*. Knapp's (1964, Ph.D. diss., Cornell Univ.) systematic study of *E. caeruleum* recognized two main groups: one consisting of an undescribed subspecies from White River drainage of MO and AR and an undescribed subspecies from Homochitto River, MS; second consisting of three races of *E. c. caeruleum*. According to Knapp (1964), *E. caeruleum* most closely related to *E. radiosum* and *E. whipplei* although superficially similar to *E. spectabile* with which it was (until 1930) considered to be conspecific (Trautman 1930. Copeia:12-13).



TN: Sumner Co., Caney Fork,
58 mm SL (NCSM).



Map modified from Knapp (1964)

DISTRIBUTION AND HABITAT: Widely distributed in small streams to medium-sized rivers throughout much of central and northeastern United States. In Mississippi and Ohio rivers basins, in part of Great Lakes drainage, entering all but Lake Superior system, and in a tributary of Arkansas River (Knapp 1964). Ranges from northern AL and central AR north to northern WI and eastern ON. Disjunct population centered in southwestern MS and LA. Recent collections by the authors show that range extends onto Atlantic slope, where the species occurs in certain head-

waters of Potomac River. Occurs over gravel and rubble; abundant throughout most of range.

ADULT SIZE: 40-65 mm SL.

BIOLOGY: Scott and Crossman (1973. *Freshwater Fishes of Canada*) reported spawning over coarse to fine gravel of rubble in riffles during spring. Midge and chironomid larvae are primary constituents of diet, but caddis flies, snails and small crayfish eaten by larger adults.

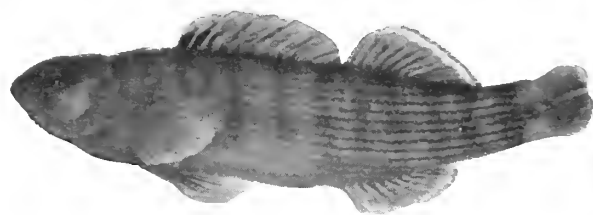
Compilers: J. R. Stauffer, Jr. and C. H. Hocutt.
September 1978.

Etheostoma camurum (Cope)
Bluebreast darter

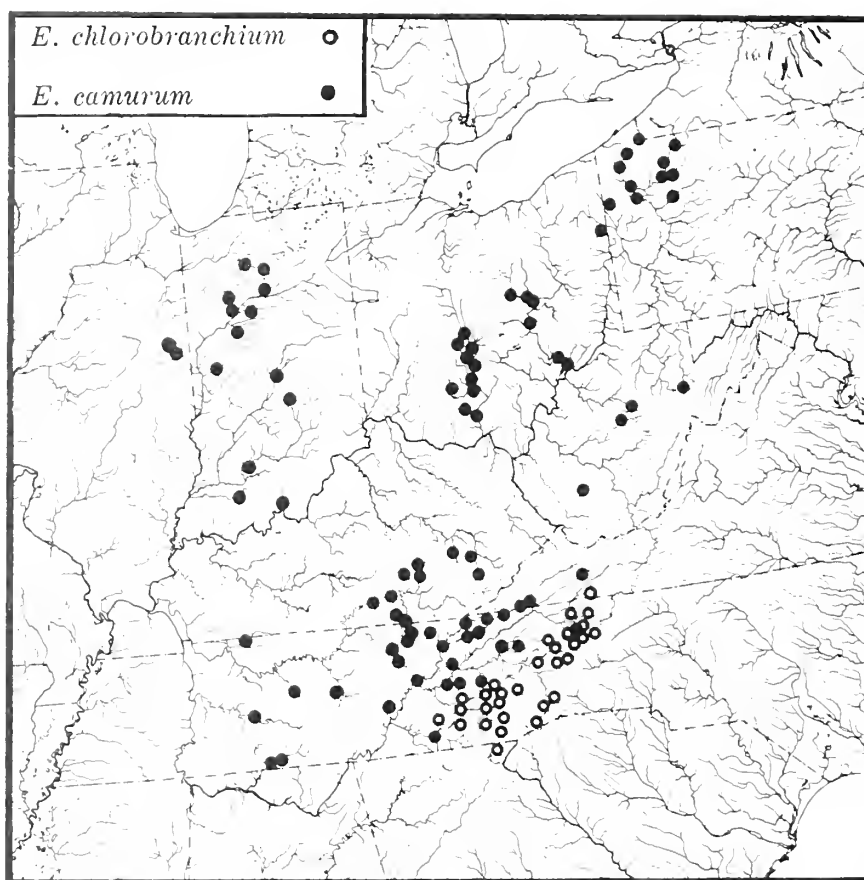
Order Perciformes
Family Percidae

TYPE LOCALITY: Headwaters of Cumberland River, TN (Cope 1870. Proc. Am. Philos. Soc. 11:261-70).

SYSTEMATICS: Subgenus *Nothonotus*. Most closely related to *E. chlorobranchium* and slightly less so to *E. bellum* (Zorach 1972. Copeia:427-47).



KY: Wayne Co., Little South Fork of Cumberland River, 50 mm SL (NCSM).



Map modified from Zorach 1972

DISTRIBUTION AND HABITAT: Ohio River basin, from Tennessee and Cumberland drainages, TN, VA, and KY, to Vermilion River, IL, and Tippecanoe River, IN, east to Kanawha and Monongahela rivers, WV, and upper Allegheny River, PA (Zorach 1972). In runs and riffles with clean, firm, often rocky substrate in medium to large streams. Rare to common; often localized.

ADULT SIZE: 35-55 mm SL.

BIOLOGY: Diet consists mostly of benthic insects, chiefly dipteran larvae. Spawns late May to early August in TN. Female buries eggs among sand and fine gravel, beside large rocks, and in riffles (Stiles 1972. Ph.D. diss., Univ. Tennessee). Mount (1959. Copeia:240-43) described spawning behavior in aquaria.

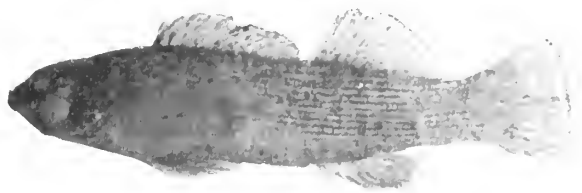
Compiler: J. R. Stauffer, Jr. September 1978.

Etheostoma chlorobranchium Zorach
Greenfin darter

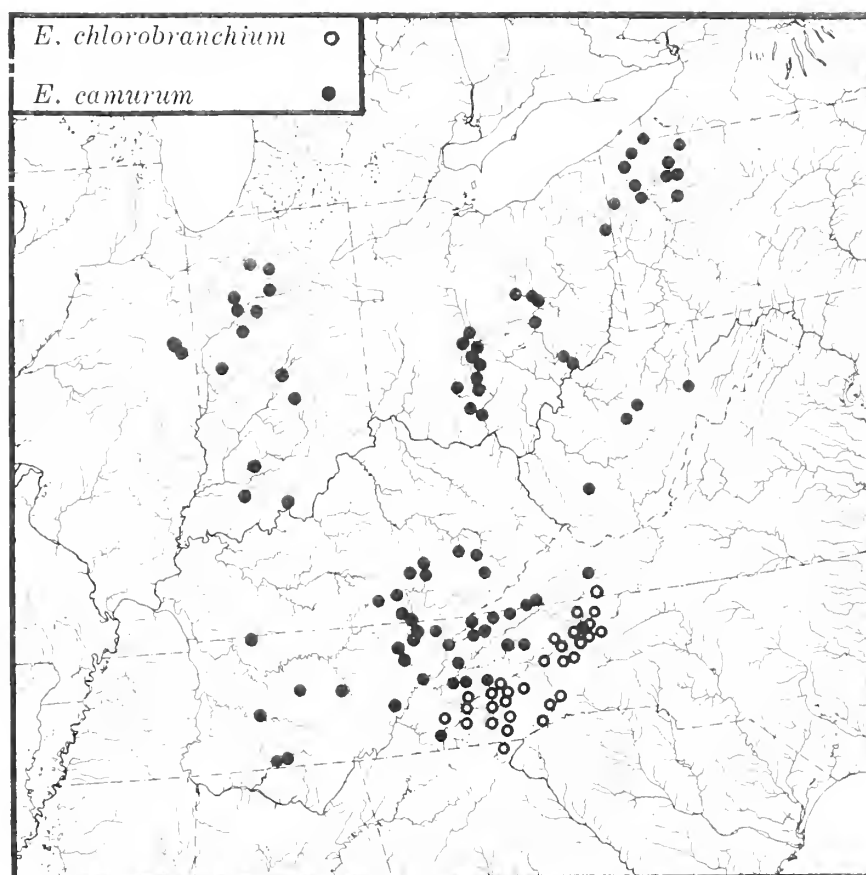
Order Perciformes
Family Percidae

TYPE LOCALITY: Cullasaja River, 10-13 km se of Franklin on Rt. 64, Macon Co., NC (Zorach 1972. Copeia :427-47).

SYSTEMATICS: Subgenus *Nothonotus*. Very closely related to *E. camurum* and distinguished in large degree by color differences (Zorach 1972).



NC: Watauga Co., Watauga River, 80 mm SL (NCSM).



Map modified from Zorach 1972

DISTRIBUTION AND HABITAT: Blue Ridge streams of upper Tennessee drainage, including South Fork Holston, Watauga, Nolichucky, French Broad, Pigeon, Little Pigeon and Little Tennessee river systems, TN, NC, VA, and GA. Much more widespread and common in NC than in TN. Rare to common in swift riffles of rubble and boulder in medium to large clear streams (Zorach 1972).

ADULT SIZE: 45-65 mm SL.

BIOLOGY: Essentially unknown. Zorach (1972) noted marked sexual dimorphism in color and size. Syntopic *Nothonotus* species are *E. acuticeps*, *E. rufilineatum* and *E. maculatum*.

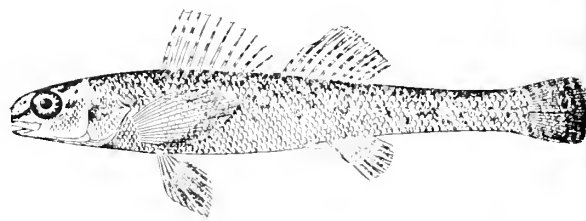
Compiler: J. R. Stauffer, Jr. September 1978.

Etheostoma chlorosomum (Hay)
Bluntnose darter

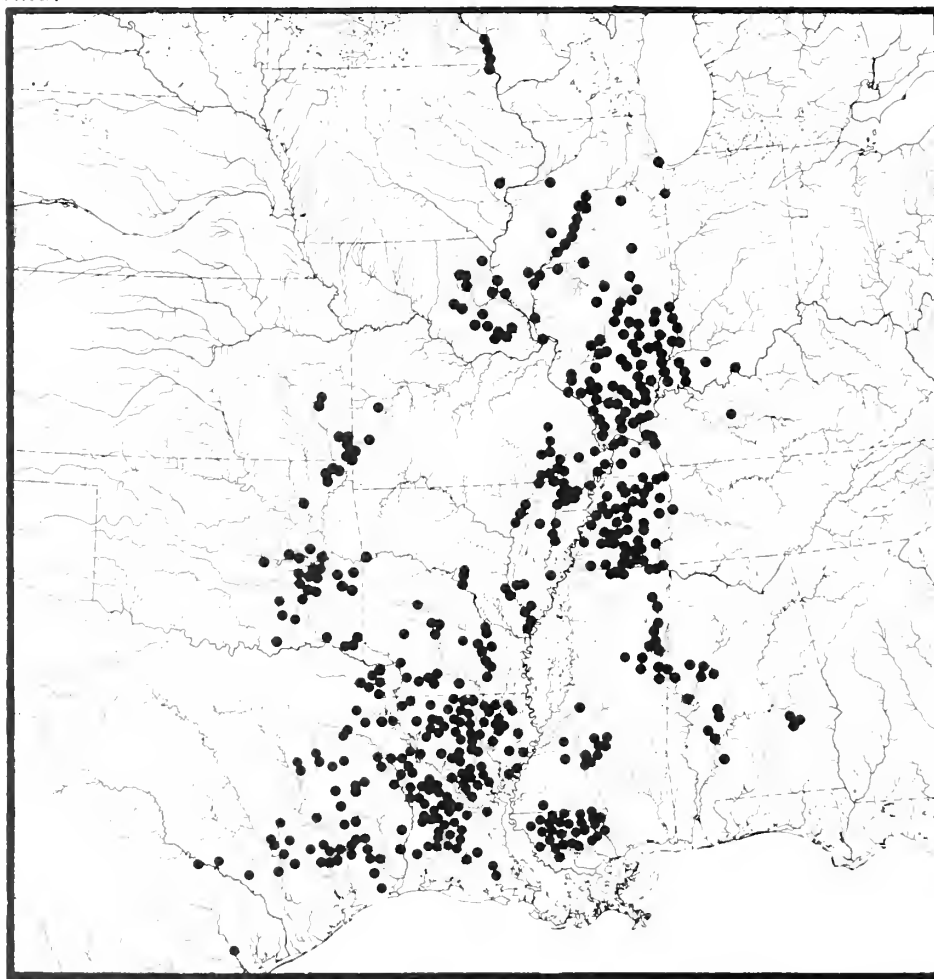
Order Perciformes
Family Percidae

TYPE LOCALITIES: Branch of Tusculum River, at Corinth, Alcorn Co., MS; Sand Creek, near Artesia, Lowndes Co., MS; and Horsehunter Creek, at Macon, Noxubee Co., MS (Hay 1881. Proc. U.S. Natl. Mus. [1880] 3:488-515).

SYSTEMATICS: Subgenus *Vaillantia* according to Cole (1967. Chesapeake Sci. 8:28-51) and Collette and Banareseu (1977. J. Fish. Res. Board Can. 34:1450-63). Closest relatives appear to be *E. davisoni* (Howell 1968. Ph.D. diss., Univ. Alabama), *E. nigrum* and *E. olmstedii*, although latter two are in subgenus *Bolcosoma*.



Illinois River (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Gulf coast, from San Antonio Bay drainage, TX, east to Mobile Bay drainage, MS and AL, but excluding several minor intervening drainages in MS and AL (Biloxi and St. Louis bays [Caldwell 1966. J. Miss. Acad. Sci. 12: 213-31]; Escatawpa River [Beckham 1977. Proc. Southeastern Fishes Council. 2:1-4]). North in Mississippi Valley to extreme southeastern MN and east to extreme south-central TN. One record, presumably valid, from Chicago, IL, area of Lake Michigan, where species evidently reached via Chicago

River drainage canal. Usually common to abundant in sluggish streams of lowlands and level, undissected uplands. In pools and backwaters without noticeable current, where bottom is sand and organic debris.

ADULT SIZE: ca. 46 mm SL maximum.

BIOLOGY: Not studied. Probably similar to that of the closely related species listed above.

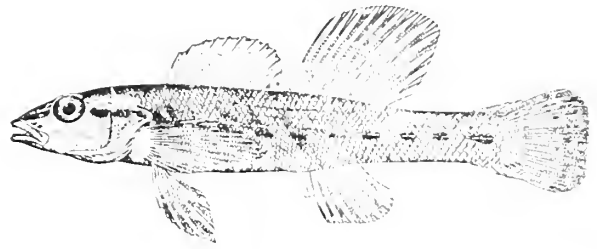
Compiler: C. R. Gilbert. November 1978.

Etheostoma cinereum Storer
Ashy darter

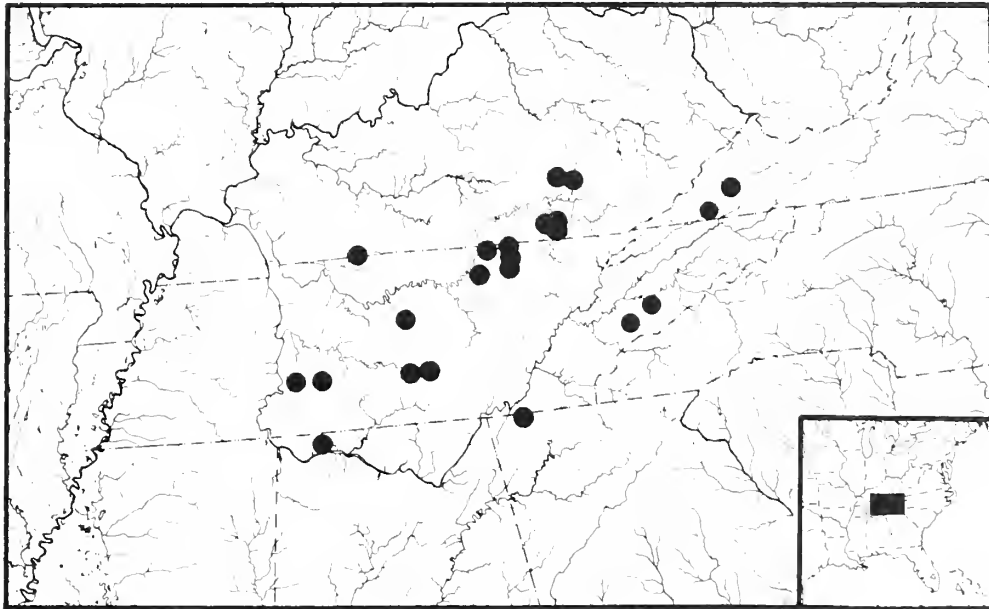
Order Perciformes
Family Percidae

TYPE LOCALITY: Tennessee River drainage at Florence, Lauderdale Co., AL (Storer 1845. Proc. Boston Soc. Nat. His. 2:47-49). Type specimens have long been lost, and this species has not been found in AL since.

SYSTEMATICS: Monotypic subgenus *Allohistium* (Bailey and Gosline 1955. Misc. Publ. Mus. Zool. Uni. Mich. 93:1-44).



TN: Wolf River, Byrdstown, ca. 77 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: In larger streams and rivers of Cumberland and Tennessee river drainages in KY, TN, AL, GA, and VA, where prefers such cover as boulders and undercut banks in little or moderate current. Never common, but less scarce than once thought. Apparently extirpated in AL and VA.

ADULT SIZE: 60-78 mm SL.

BIOLOGY: Essentially nothing known. Occurs in low numbers.

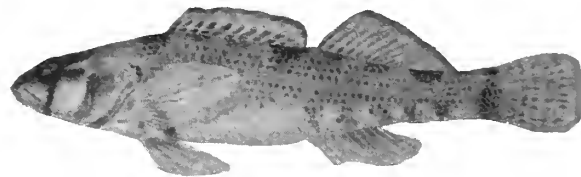
Compiler: C. F. Saylor. May 1978.

Etheostoma collettei Birdsong and
Knapp
Creole darter

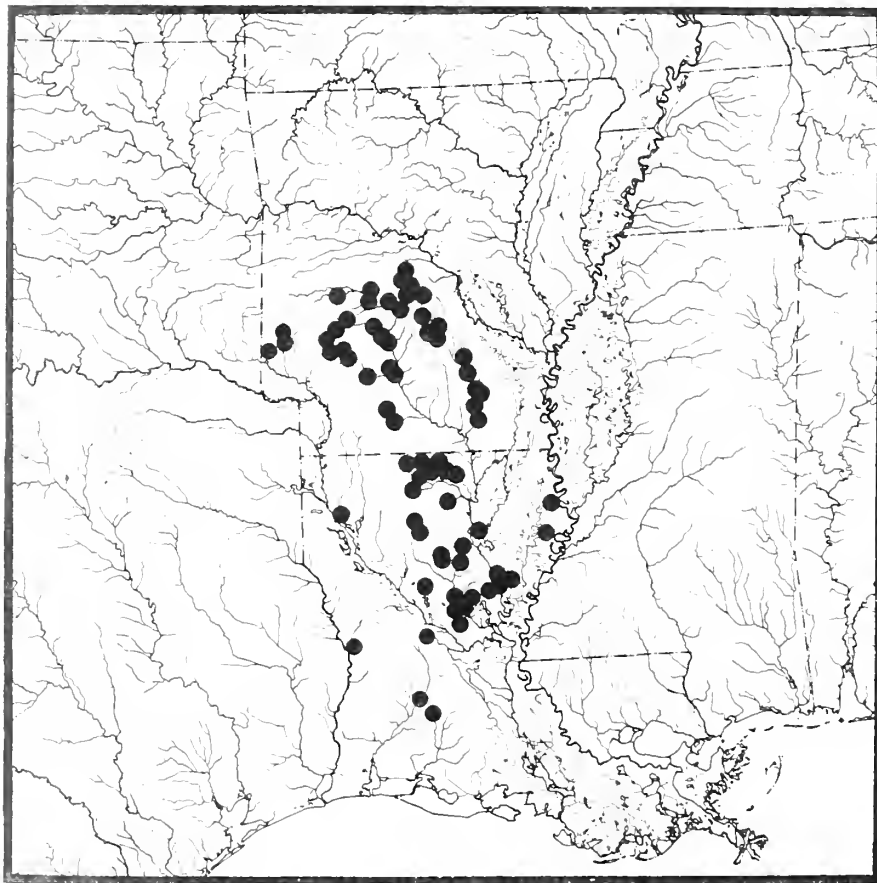
Order Perciformes
Family Percidae

TYPE LOCALITY: Dugdemuna River, Little River drainage, T15N, R3W, Sec. 6, Jackson Par., LA (Birdsong and Knapp 1969. Tulane Stud. Zool. Bot. 15:106-12).

SYSTEMATICS: Subgenus *Oligocephalus*. Possibly most closely related to *E. asprigene* with which it was formerly confused, but differences in shape of female urogenital papilla and nature and distribution of nuptial tubercles argue against their close relationship.



Holotype, male, 56 mm SL
(Birdsong and Knapp 1969).



DISTRIBUTION AND HABITAT: Known from Ouachita and Little river systems in AR and LA and Little, Red, and Sabine drainages in LA. Largely a headwater species, occurring in several types of habitat, sometimes occurring in moderate to fast-flowing streams 3-6 m wide over a hard soil substrate without rocks or gravel. At other times has been taken in gravelly riffles and still other times in rocky chutes with heavy submergent vegetation. Fairly common.

ADULT SIZE: 41-62 mm SL, 72 mm TL maximum.

BIOLOGY: No definitive biological study has been published.

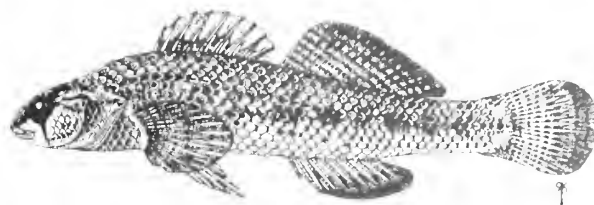
Compilers: S. P. Platania and H. W. Robison.
September 1978.

Etheostoma collis (Hubbs and Cannon)
Carolina darter

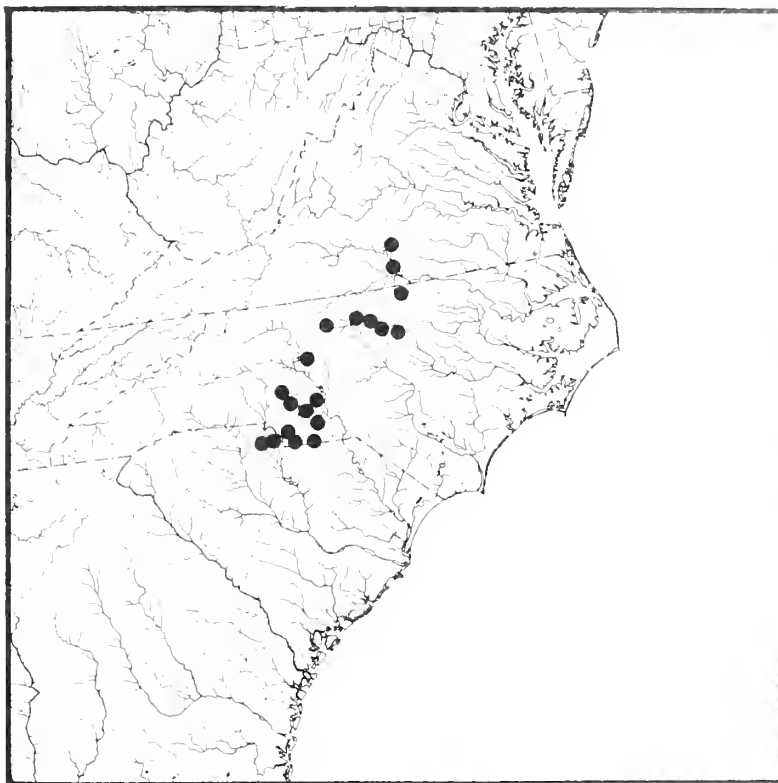
Order Perciformes
Family Percidae

TYPE LOCALITY: Creek near York, York Co., SC (Hubbs and Cannon 1935. Misc. Publ. Mus. Zool. Univ. Mich. 30:1-93).

SYSTEMATICS: Subgenus *Hololepis*. Collette (1962. Tulane Stud. Zool. 9:115-211) reviewed species. Probably most advanced species of subgenus; very closely related to *E. saldae*. Collette (1962) described subspecies *E. c. lepidinion*.



NC: Union Co., north fork Crooked Creek, male, 50 mm SL (NCSM).



DISTRIBUTION AND HABITAT: *Etheostoma c. collis* is restricted to Rocky and Yadkin systems, Pee Dee drainage, NC and SC, and Catawba-Wateree system, Santee drainage, SC, above Fall Line. *Etheostoma c. lepidinion* is in Piedmont systems of Roanoke, Neuse, and possibly Cape Fear drainages of VA and NC. Inhabitant of backwater pools or near banks of slow-moving, small streams, 1.5-12 m wide and 0.6-0.9 m deep, with sand, mud, or rubble substrate covered by silt or detritus. Infrequently taken; apparently localized and generally may be rare (Collette 1962).

ADULT SIZE: 30-43 mm SL.

BIOLOGY: Virtually unknown. Breeding season apparently near end of March (Collette 1962).

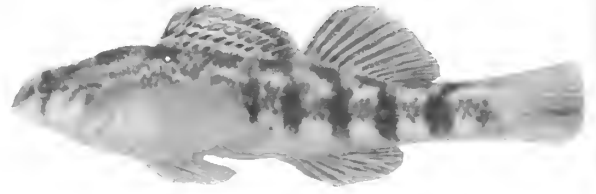
Compiler: C. H. Hocutt. May 1978.

Etheostoma coosae (Fowler)
Coosa darter

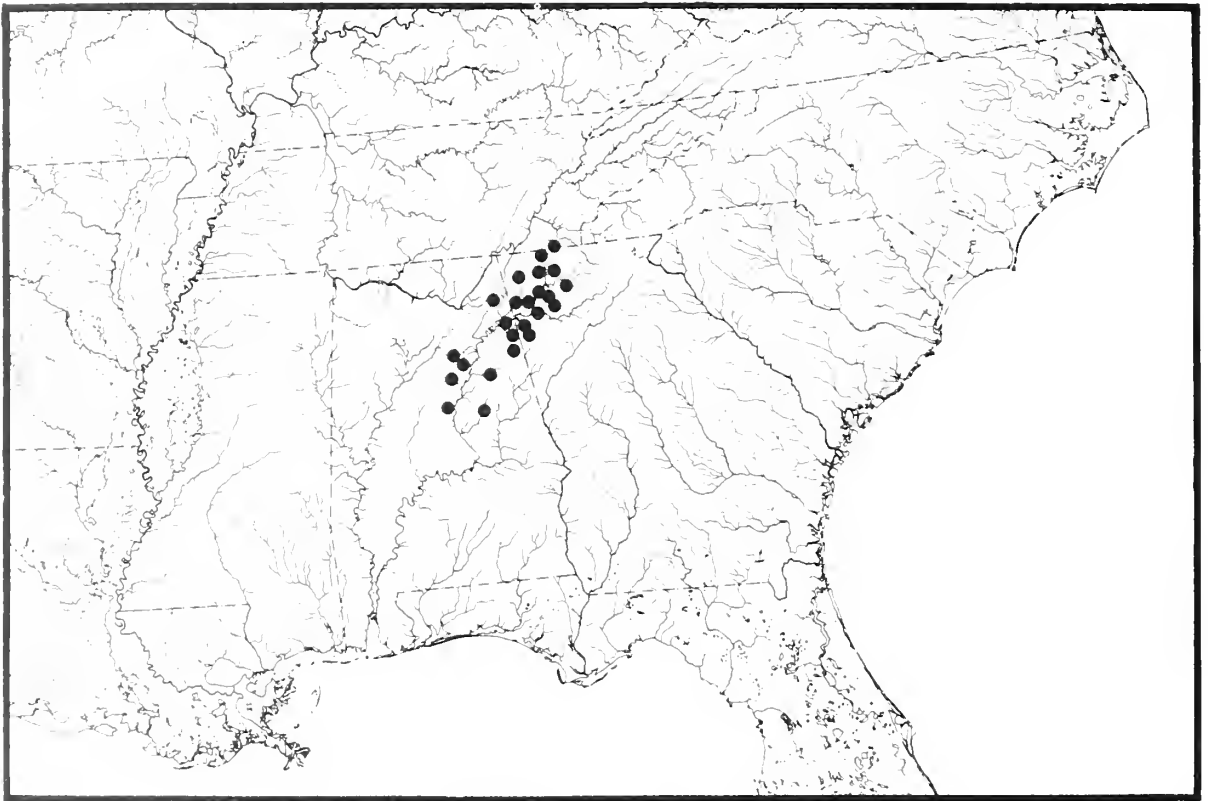
Order Perciformes
Family Percidae

TYPE LOCALITY: Small creek, ca. 0.4 km ne of Chesterfield, Cherokee Co., AL (Fowler 1945. Monogr. Acad. Nat. Sci. Phila. 7:1-408).

SYSTEMATICS: Subgenus *Ulocentra*. Distinguished from all other members of subgenus by having 6 (versus 5) branchiostegal rays, and thus considered to be most primitive species of *Ulocentra*.



GA: Whitfield Co., Coosa River system, male, 56 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Endemic to Coosa River system (Mobile Bay basin) of AL, GA, and TN. Typically in small to moderate size, clear streams with rubble bottom, where it usually occurs in areas of slow to moderate current.

ADULT SIZE: ca. 60 mm SL maximum.

BIOLOGY: Not studied. Presumably similar in most respects to that of other species in the subgenus *Ulocentra*.

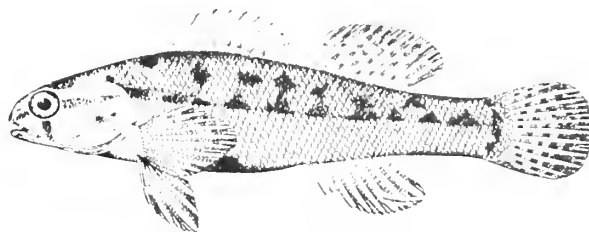
Compiler: C. R. Gilbert and L. M. Page.
April 1980.

Etheostoma cragini Gilbert
Arkansas darter

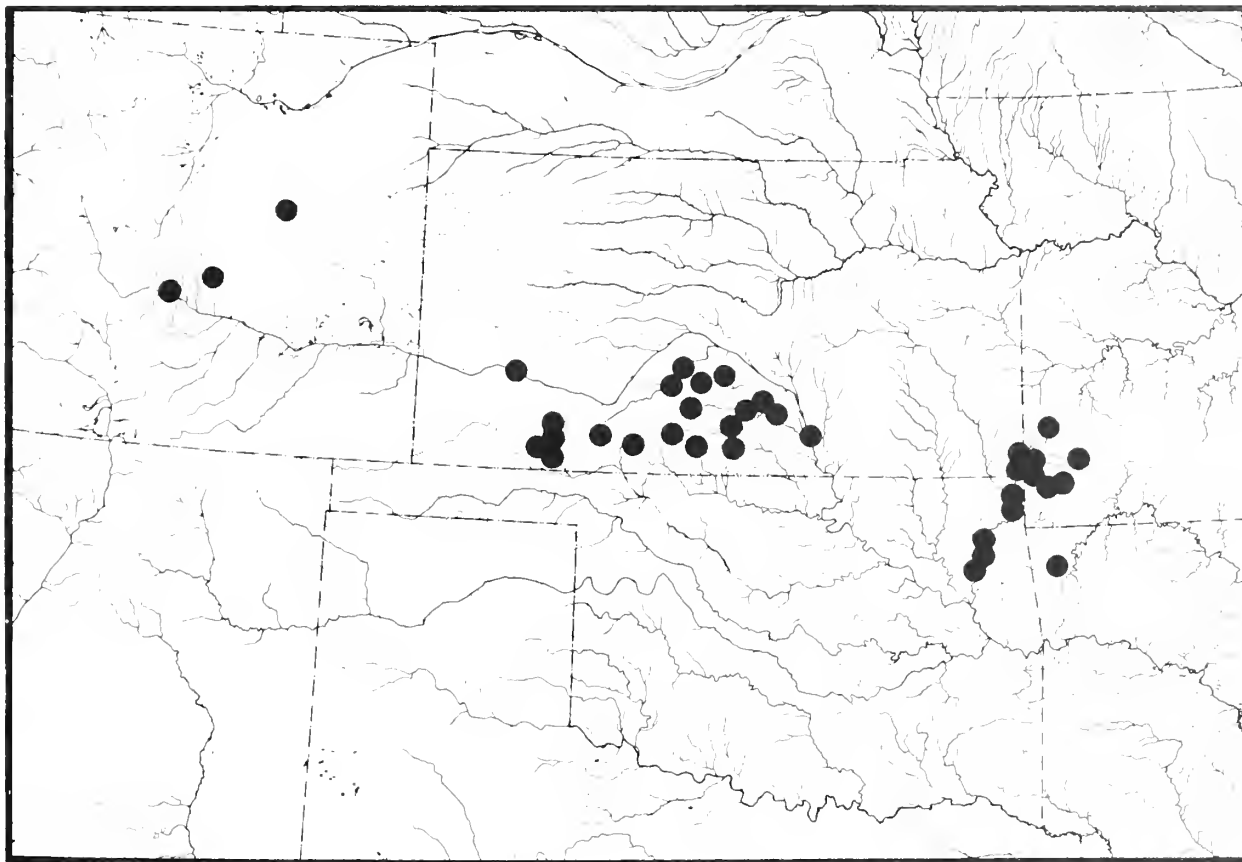
Order Perciformes
Family Percidae

TYPE LOCALITY: Small tributary of Arkansas River at Garden City, KS (Gilbert 1885. Bull. Washburn Lab. Nat. Hist. 1:97-99).

SYSTEMATICS: Subgenus *Oligocephalus*. Appears to be in a species group with *E. boschungii*, *E. pallididorsum*, and *E. punctulatum* (Wall and Williams 1974. Tulane Stud. Zool. Bot. 18:172-82).



MO: Spring Branch at Neosha
(Jordan and Evermann 1900)



DISTRIBUTION AND HABITAT: Occurs as localized populations in Arkansas drainage in eastern CO (Ellis and Jaffa 1918. Copeia: 73-75), southern KS, northeastern OK, and southwestern MO. Inhabits spring runs or small creeks with abundance of watercress or other aquatic vegetation. Most often found in pools with sand, fine gravel, or organic detritus substrate. Much local extirpation has possibly occurred in the last century due to drought and increased turbidity. Recent drying of creeks resulting from increased irrigation has eliminated much suitable habitat in the western portion of its range.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Specimens with breeding colors have been taken from mid-February through May (Ellis and Jaffa 1918; Cross 1967. Univ. Kans. Mus. Nat. Hist. Misc. Publ. 4:1-357). Spawning occurs in shallow water over coarse gravel (Pflieger 1975. *The Fishes of Missouri*). Distler (1972. Southwest. Nat. 16:439-41) described the reproductive habits of captives.

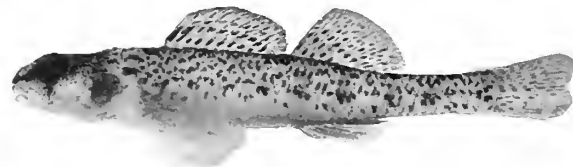
Compiler: D. G. Cloutman. May 1978.

Etheostoma davisoni Hay
Choctawhatchee darter

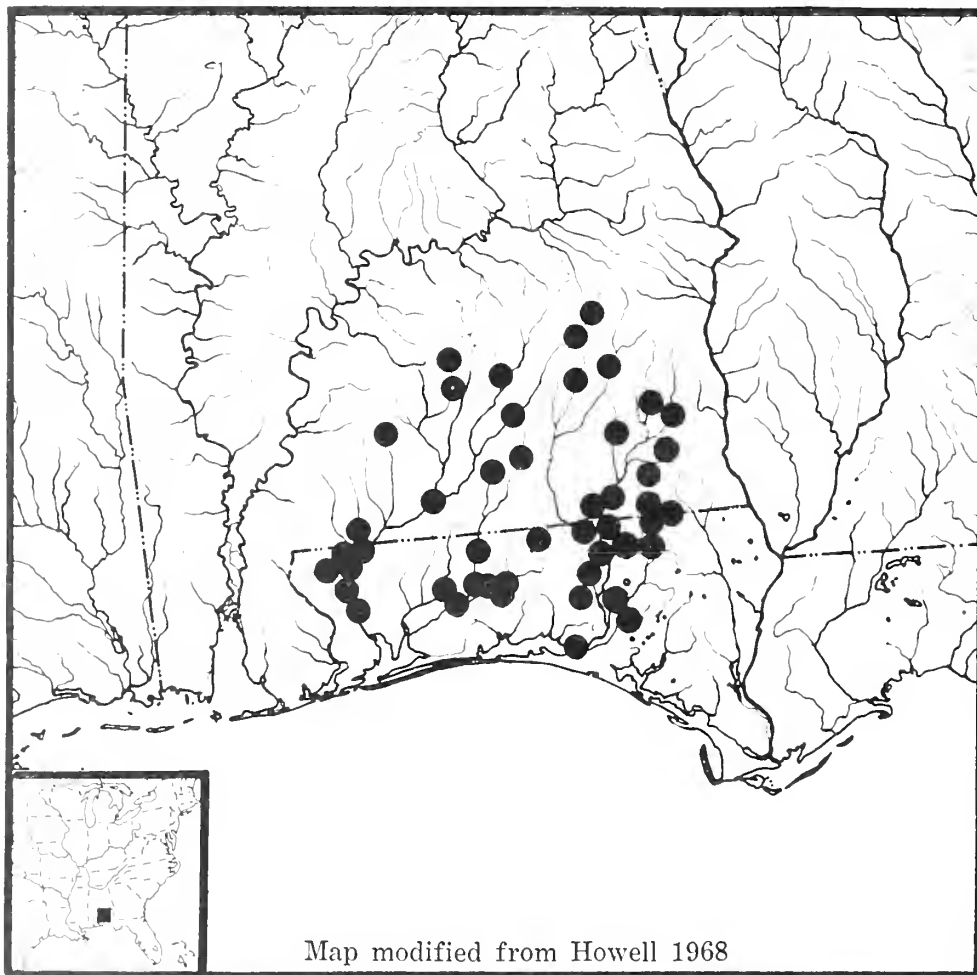
Order Perciformes
Family Percidae

TYPE LOCALITY: Yellow River near Chaffin, Santa Rosa Co., FL (Hay 1885. Proc. U. S. Natl. Mus. 8:552-59).

SYSTEMATICS: Resurrected from synonymy of *E. stigmaeum* (Howell 1968. Ph.D. diss., Univ. Alabama). More closely related to *E. chlorosomum* (subgenus *Vaillantia*) than to *E. stigmaeum* (subgenus *Doration*). Differs from *E. stigmaeum* in lacking blue and red-orange nuptial colors in breeding males, by having villose rather than tubular genital papilla in females, and by lacking breeding tubercles. Differs from *E. chlorosomum* by lacking breeding tubercles.



AL: Geneva Co., Spring Creek, male, 46 mm SL (W. M. Howell).



DISTRIBUTION AND HABITAT: Small to large, sand and gravel-bottomed streams, generally in slower pools above and below riffle areas in Choctawhatchee system and Pensacola Bay drainage of south AL and northwest FL.

BIOLOGY: Paucity of information. Males collected in breeding colors from 19 March through 25 May.

ADULT SIZE: 38-45 mm SL.

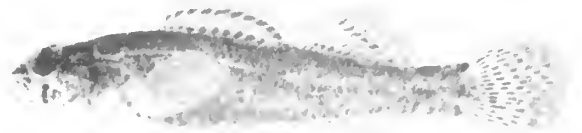
Compiler: W. M. Howell. October 1978.

Etheostoma ditrema Ramsey and
Suttkus
Coldwater darter

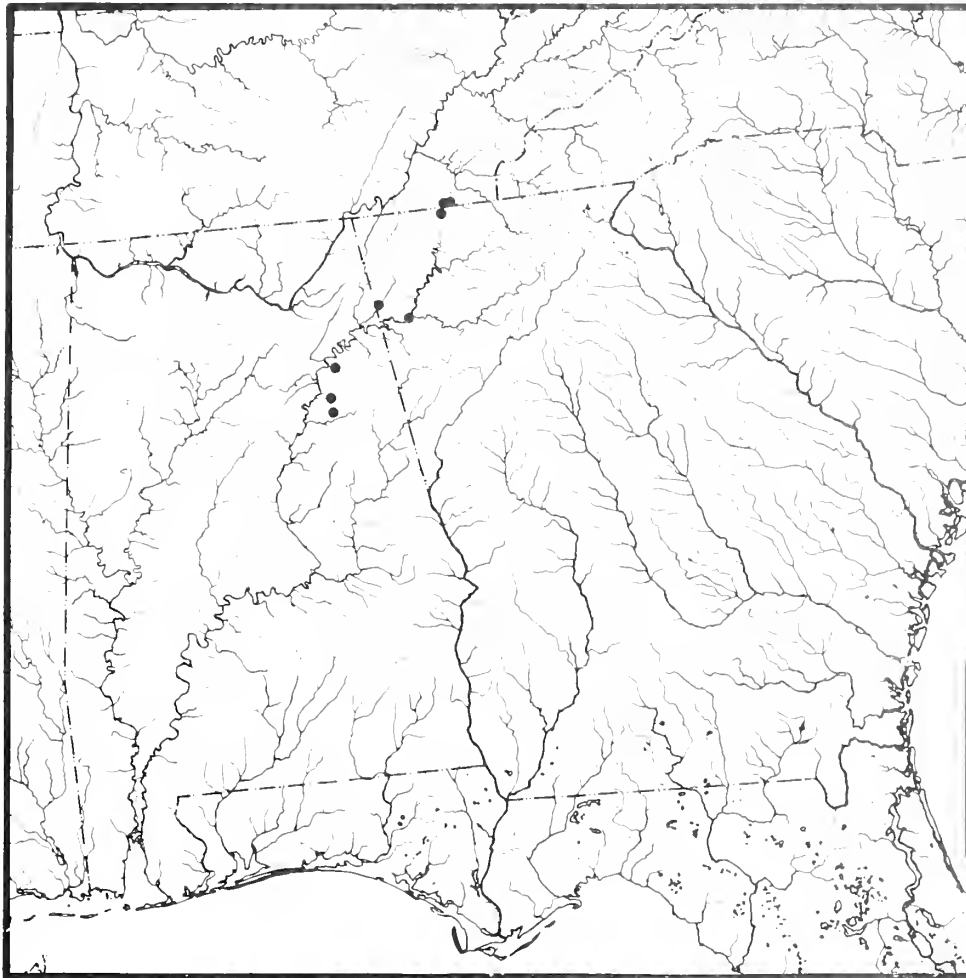
Order Perciformes
Family Percidae

TYPE LOCALITY: Spring flowing into a small tributary to Mills Creek, tributary to Chattooga River, 6.9 km due west of Lyerly, Chattooga Co., GA (Ramsey and Suttkus 1965, Tulane Stud. Zool. 12:65-77).

SYSTEMATICS: Subgenus *Oligocephalus*. Closely allied with *E. swaini-asprigene* species group.



GA: Murray Co., Conasauga River drainage, 49 mm SL (J.L. Harris).



DISTRIBUTION AND HABITAT: Upper Coosa-Alabama River drainage (Coosa River Valley) above Fall Line in northwest GA, northeast AL, and extreme southeast TN. In AL occurs in Coldwater Spring and Martin Spring (impounded), Calhoun Co. (Ramsey 1976, Bull. Ala. Mus. Nat. His. 2:53-65) and an unnamed spring in Etowah Co. In GA, known from type locality, one collection made in 1876 from Millpond, Etowah River drainage, Floyd Co. (Ramsey and Suttkus 1965), and several localities in Conasauga River drainage (all not shown on map).

ADULT SIZE: 25-35 mm SL, 42 mm SL maximum.

BIOLOGY: Males assume nuptial coloration by end of April and through mid-July. Females gravid April through July but usually spent by July. Ramsey and Suttkus (1965) provided reproductive data and egg numbers vs. female size.

Compiler: S. P. Platania, February 1978.

Etheostoma duryi Henshall
Blackside snubnose darter

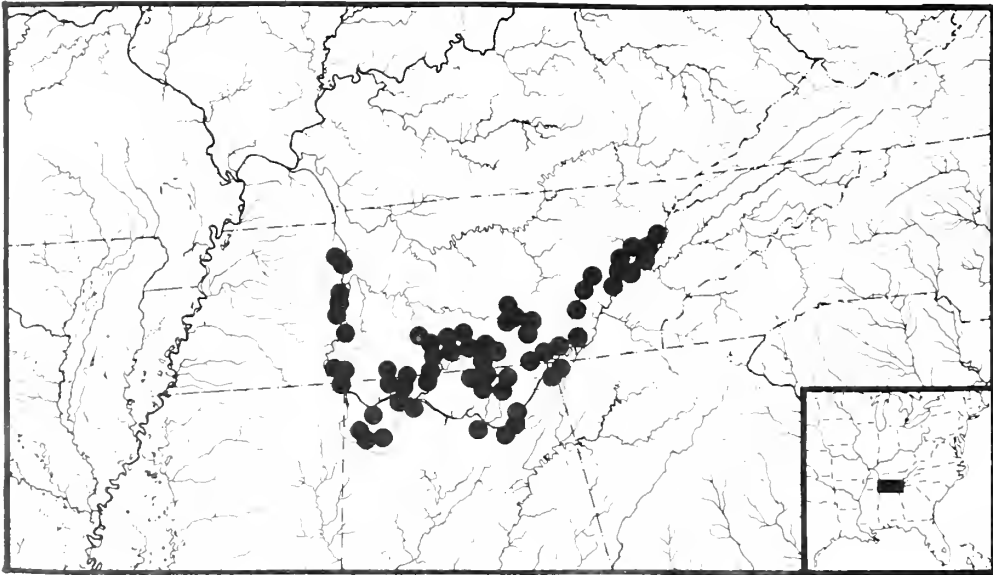
Order Perciformes
Family Percidae

TYPE LOCALITY: Small tributary to Tennessee River at Whiteside, Marion Co., TN (Henshall 1889. J. Cincinnati Soc. Nat. Hist. 12:31-33).

SYSTEMATICS: Subgenus *Ulocentra*. Most closely related to an undescribed species which replaces it to the north, and differs in having orange lips in life, and in other details of pigmentation.



TN: Coffee-Grundy Co., Elk River, 47 mm SL (NCSM).



DISTRIBUTION AND HABITAT: A species of springs and small to medium, clear, gravel bottom streams. Most of range very close to main channel of Tennessee River, from mouth of Clinch River downstream to just below mouth of Duck River. Widespread in Elk River system, and present in upper Duck River system, Coffee Co., TN. Broadly sympatric with *E. simoterum* (which has a frenum, lacking in *E. duryi*), and sympatric with this species and its undescribed close relative in Richland Creek portion of Elk River system and probably elsewhere. In western tributaries to lower Tennessee River,

E. duryi occurs in gravel bottom streams of Western Highland Rim Physiographic Province, while an additional undescribed *Ulocentra* (with banded dorsal fins) occupies streams in Mississippi River Embayment Physiographic Province. The two are not known to be sympatric.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Unstudied.

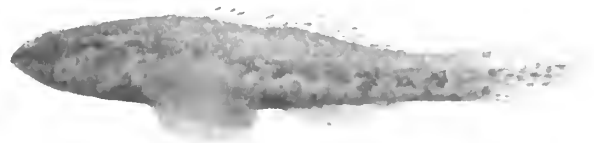
Compiler: D. A. Etnier. June 1978.

Etheostoma edwini (Hubbs and
Cannon)
Brown darter

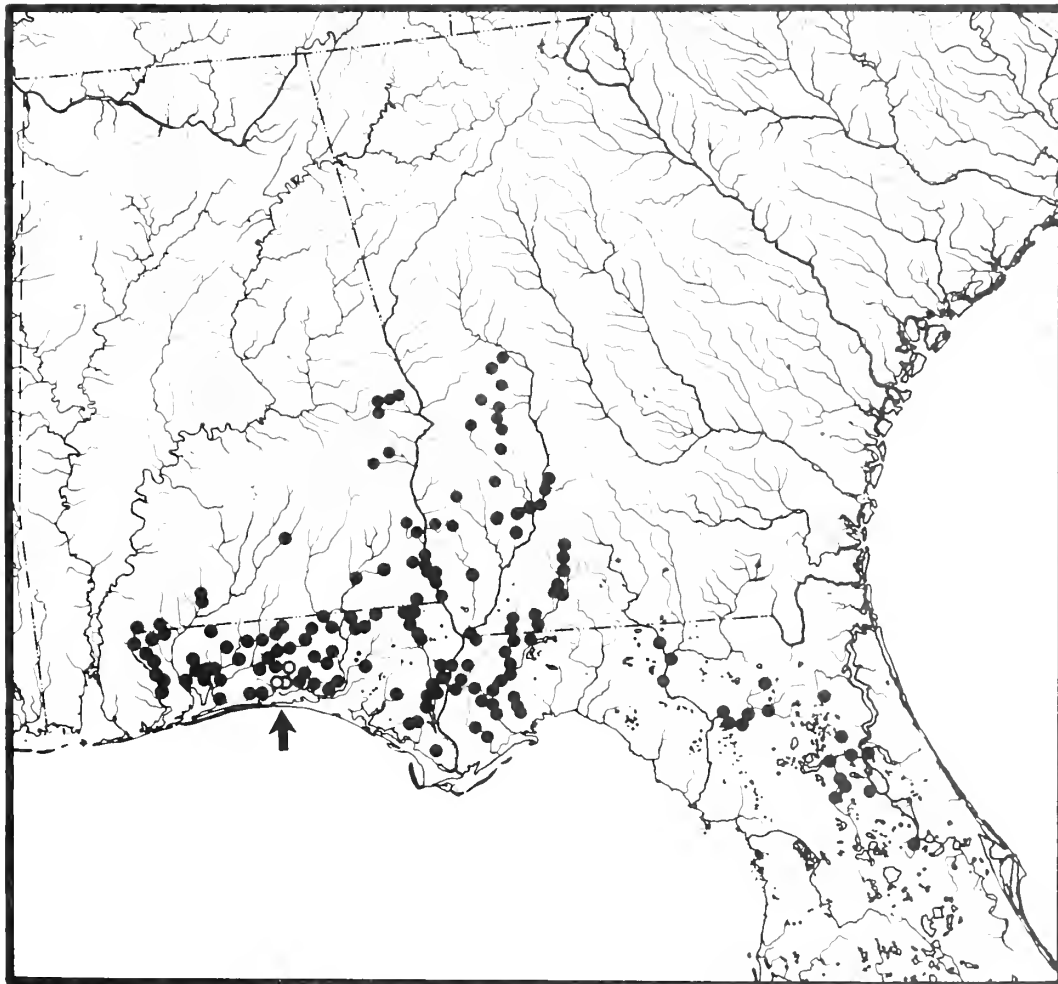
Order Perciformes
Family Percidae

TYPE LOCALITY: Santa Fe River, Poe Springs, FL (Hubbs and Cannon 1935. Misc. Publ. Mus. Zool. Univ. Mich. 30:1-93).

SYSTEMATICS: Subgenus *Villora*. Most closely related to *E. okaloosae*. Collette and Yerger (1962. Tulane Stud. Zool. 9:213-30) reviewed systematics.



AL: Baldwin Co., Perdido River system, male, 40 mm SL (Smith-Vaniz 1968).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: Coastal Plain of St. Johns River in northeast FL; west to Perdido River in western FL and southern AL, and north into GA to Fall Line (Collette and Yerger 1962). Most frequently associated with leaves or scattered vegetation along margins of streams (Collette and Yerger). Lee and Franz (pers. comm.) commonly found specimens under large flat rocks of springfed streams in western FL.

ADULT SIZE: 43 mm SL maximum.

BIOLOGY: John Williams (M. Sc. thesis, Univ. West Florida) studied biology and life history. Lee et al. (pers. comm.) studied feeding behavior and found heavy predation on caddis fly larvae and nocturnal foraging. Since 1964 has been collected at certain localities in Choctawhatchee Bay drainage (presumably introduced) and has gradually replaced *E. okaloosae* where sympatric (Mettee et al. 1976. Proc. Southeast. Fishes Council. 1:1-4).

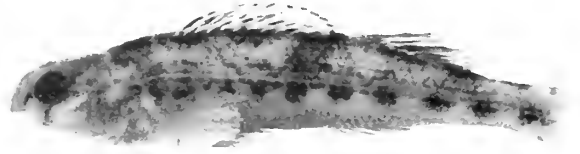
Compilers: J. Stauffer, Jr., and C. H. Hocutt. February 1978.

Etheostoma etnieri Bouchard
Cherry darter

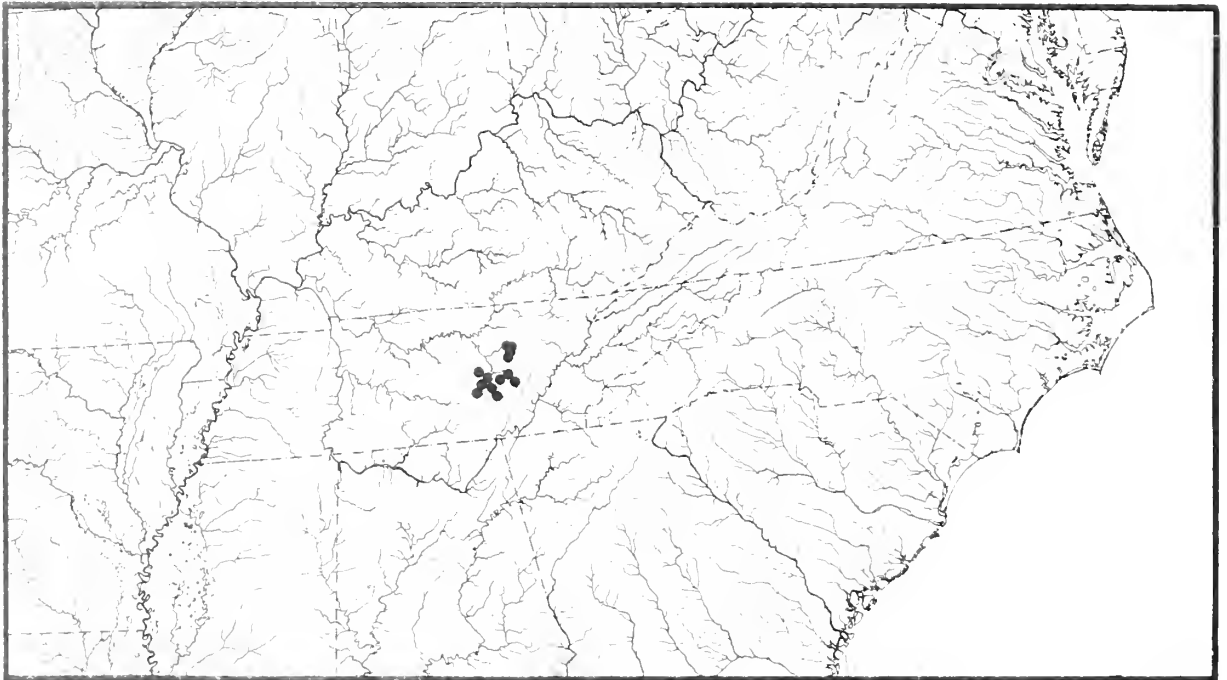
Order Perciformes
Family Percidae

TYPE LOCALITY: Cherry Creek, tributary to Calfkiller River of Caney Fork (Cumberland) River system, at TN state hwy. 84, 8.5 km ne of intersection U.S. hwy. 70 and TN state hwy. 84, Sparta, White Co., TN (Bouchard 1977, Tulane Stud. Zool. Bot. 19:105-30).

SYSTEMATICS: Subgenus *Ulocentra*. Close affinities with *Etheostoma duryi*.



TN: White Co., Wildcat Creek,
42 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to Caney Fork system of Cumberland drainage, TN. Limited to streams flowing over limestones of Mississippian Eastern Highland Rim. Prefers small to medium-sized streams and creeks, but has also been collected in large rivers, in runs and riffles of moderate to low turbulence over a gravel substrate. May be common in preferred habitat.

ADULT SIZE: 44-64 mm SL.

BIOLOGY: Not studied.

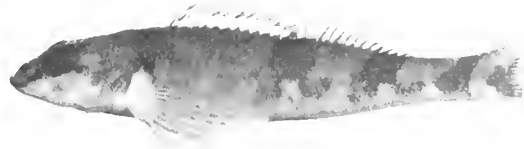
Compiler: S. P. Platania. May 1978.

Etheostoma euzonum
(Hubbs and Black)
Arkansas saddled darter

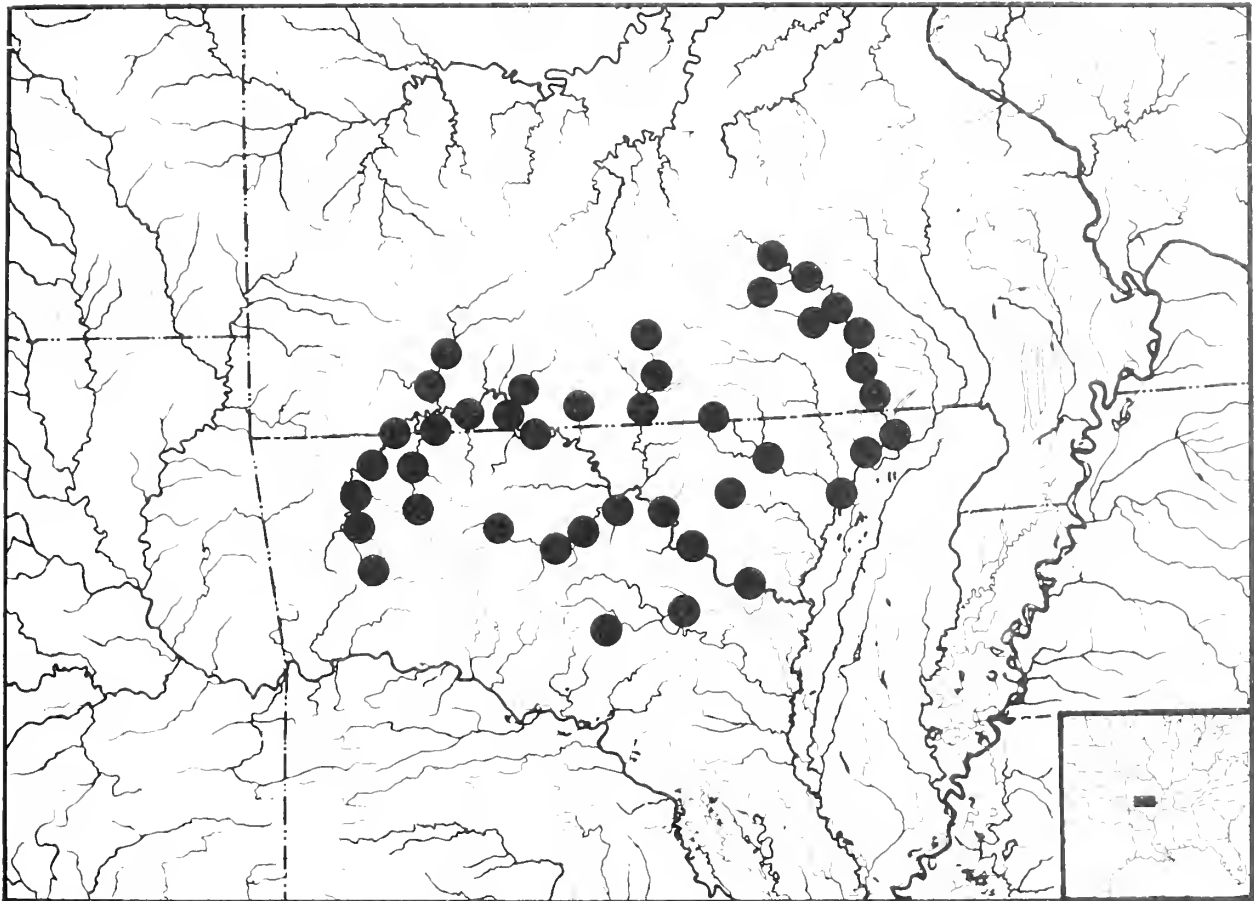
Order Perciformes
Family Percidae

TYPE LOCALITY: Buffalo River, 6.4 km se of St. Joe, Searcy Co., AR (Hubbs and Black 1940. Occas. Pap. Mus. Zool. Univ. Mich. 416:1-30).

SYSTEMATICS: Subgenus *Etheostoma*. Member of *E. variatum* group. Replaces closely related *E. tetrazonum* in southern Ozarks. Hubbs and Black (1940) described two subspecies, *E. e. crizonum* and *E. e. euzonum*.



MO: Taney Co., Beaver Creek,
74 mm SL (Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: Endemic to White drainage in Ozarks of AR and MO. *E. e. euzonum* occurs in White River system proper above Batesville, AR, and typical *E. e. crizonum* known from Current River system; intergrades occupy other parts of White drainage (Hubbs and Black 1940; Pflieger 1971. Univ. Kans. Publ. Mus. Nat. Hist. 20: 225-570). Found in high gradient, clear streams over coarse gravel and rock substrate (Pflieger 1975. *The Fishes of Missouri*). Often common in preferred habitat.

ADULT SIZE: 60-90 mm SL.

BIOLOGY: Although no specific information available, life history aspects presumably similar to those of closely related *E. tetrazonum* (Pflieger 1975) and *E. variatum*.

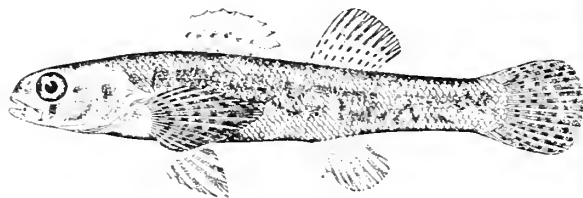
Compilers: J. R. Stauffer, Jr., C. H. Hocutt,
and C. R. Gilbert. March 1978.

Etheostoma exile (Girard)
Iowa darter

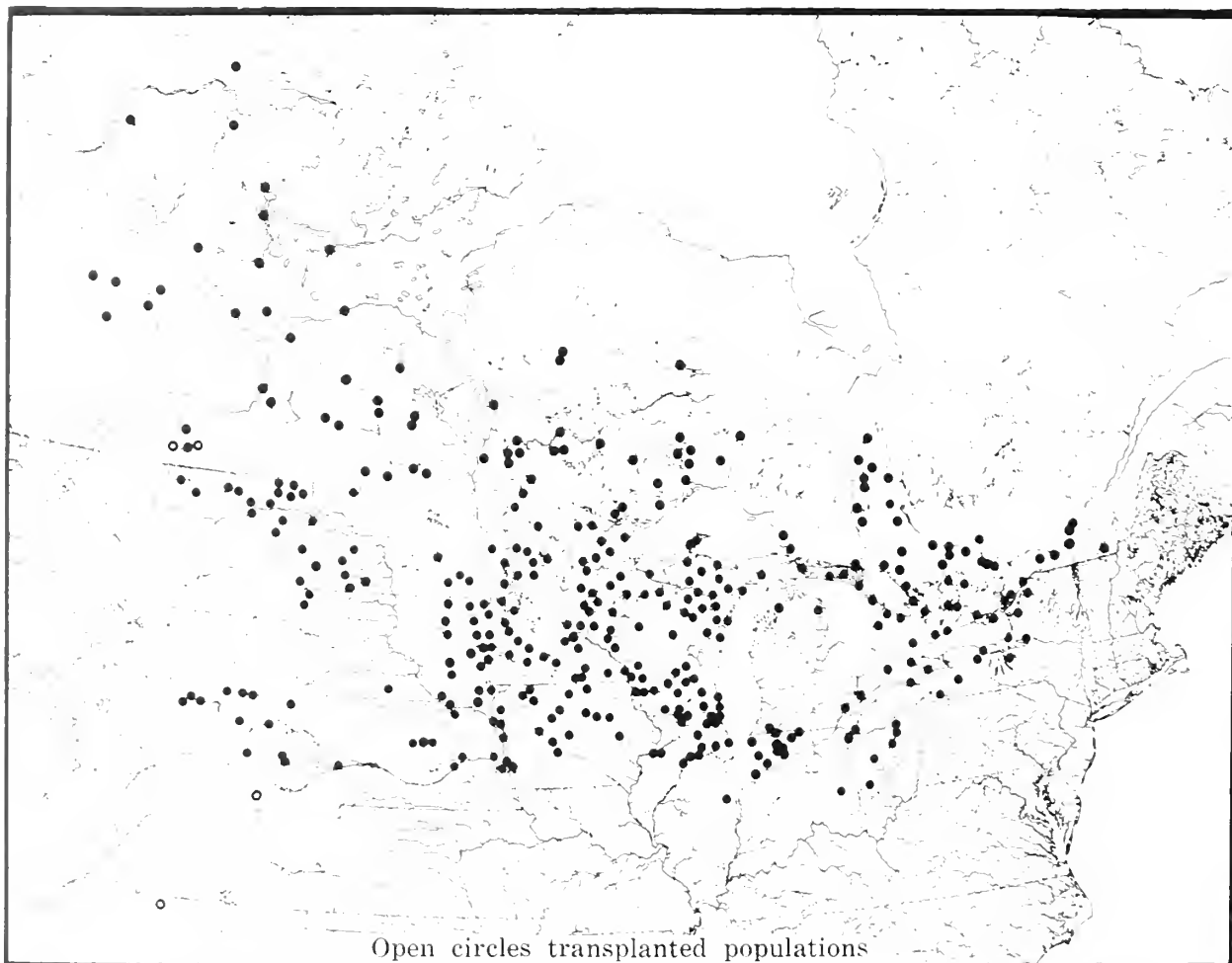
Order Perciformes
Family Percidae

TYPE LOCALITY: Little Muddy River, tributary upper Missouri River, ND (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:100-04).

SYSTEMATICS: Subgenus *Oligocephalus*. Distinctive form of uncertain affinity, possibly near line leading to subgenus *Hololepis* (Collette 1962. Tulane Stud. Zool. 9:115-211). Gosline (1947. Occas. Pap. Mus. Zool. Univ. Mich. 500:1-23) studied meristic and morphometric variation. Scott and Crossman (1973. *Freshwater Fishes of Canada*), Gosline (1947) and others provided information on variability.



WI: Pomme de Terre River, Appleton (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Throughout much of interior of southern Canada and northern United States. Introduced into NM. Common inhabitant of clear, cool lakes and slow-flowing rivers with ample submergent aquatic vegetation and substrates of sand, peat, and/or organic debris.

ADULT SIZE: 51-58 mm TL.

BIOLOGY: Winn (1958. Am. Midl. Nat. 59: 190-212) provided information on reproduction and growth. Turner (1921. Ohio J. Sci. 22:41-62) studied feeding behavior, and Bangham and Hunter (1939. Zoologica 24: 385-448) examined parasites. Scott and Crossman (1973) provided summary of biological information.

Compilers: D. S. Lee and C. R. Gilbert.
June 1978.

Etheostoma flabellare Rafinesque
Fantail darter

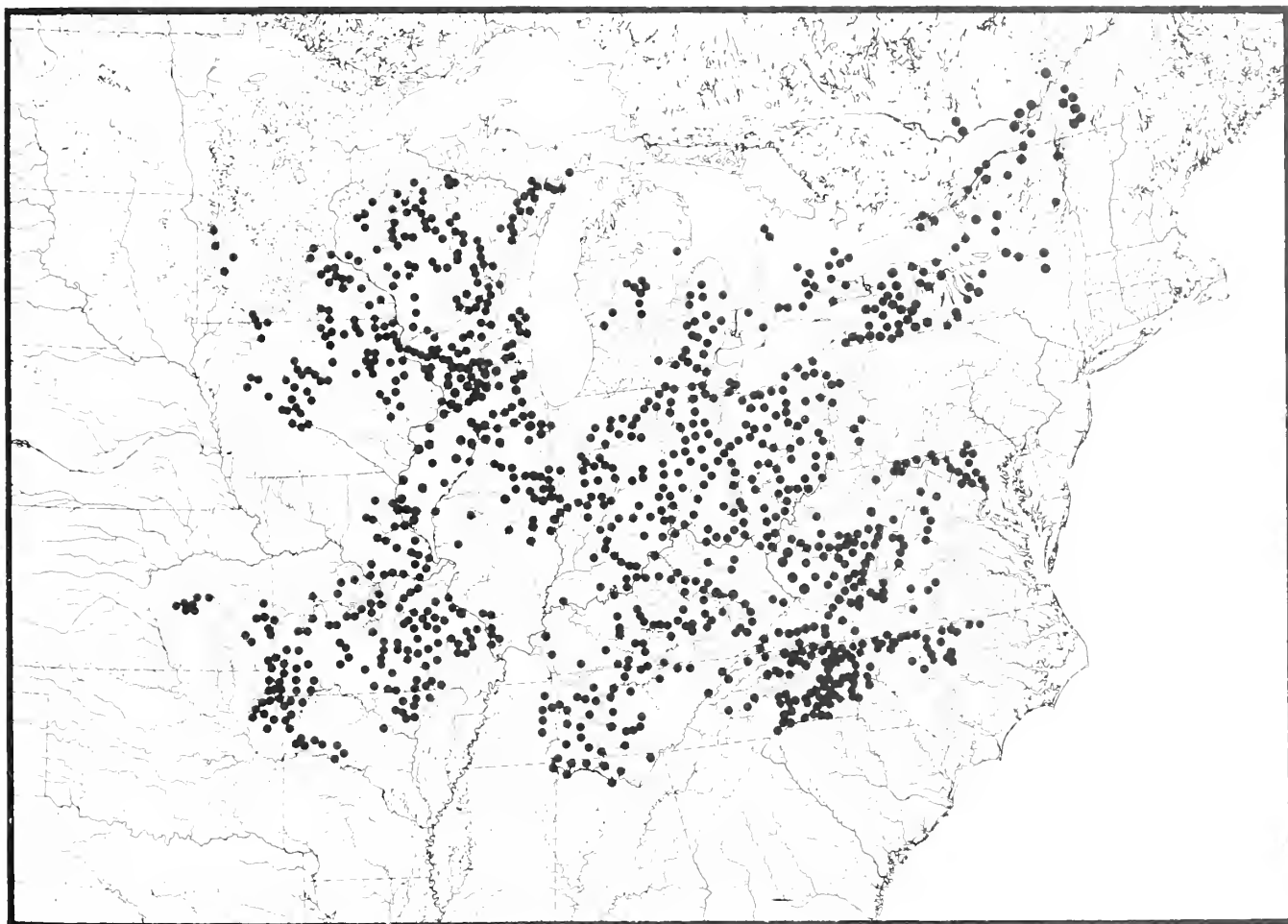
Order Perciformes
Family Percidae

TYPE LOCALITY: Ohio River (Rafinesque 1819. J. Physique, Paris 88:417-29).

SYSTEMATICS: Subgenus *Catonatus*. Species needs revision. Three subspecies presently recognized (*E. f. flabellare*, *E. f. brevispine*, *E. f. lincolatum*), but future study likely will reveal other valid forms, both species and subspecies.



MD: Washington Co., Fifteen
Mile Creek, 48 mm TL
(NCSM).



DISTRIBUTION AND HABITAT: Essentially Mississippi basin, Great Lakes and central Atlantic slope species; MS north and east to QU and NY. Occupies small to medium-sized, shallow, gravel-bottomed streams with slow to swift current for spawning and deeper water in which to overwinter. Occasionally in lakes.

ADULT SIZE: 33-71 mm TL, 76 mm TL maximum.

BIOLOGY: Lake (1936. Am. Midl. Nat. 17:816-30) investigated life history in NY and Winn (1958a. Ecol. Monogr. 28:155-91; 1958b. Am. Midl. Nat. 59:190-212) examined comparative reproductive behavior of this and other darters. Developmental stages described by Fish (1932. Bull. U.S. Bur. Fish. 47:293-398), Lake (1936), and Cooper (1979. Trans. Am. Fish. Soc. 108:46-56). Karr (1964. Proc. Iowa Acad. Sci. 71:274-80) reported on age, growth, fecundity, and feeding, and Turner (1921. Ohio J. Sci. 22: 41-62) indicated diet primarily of mayfly larvae in OH.

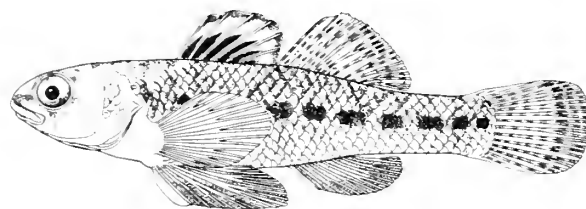
Compiler: D. S. Lee. July 1979.

Etheostoma fonticola (Jordan and Gilbert)
Fountain darter

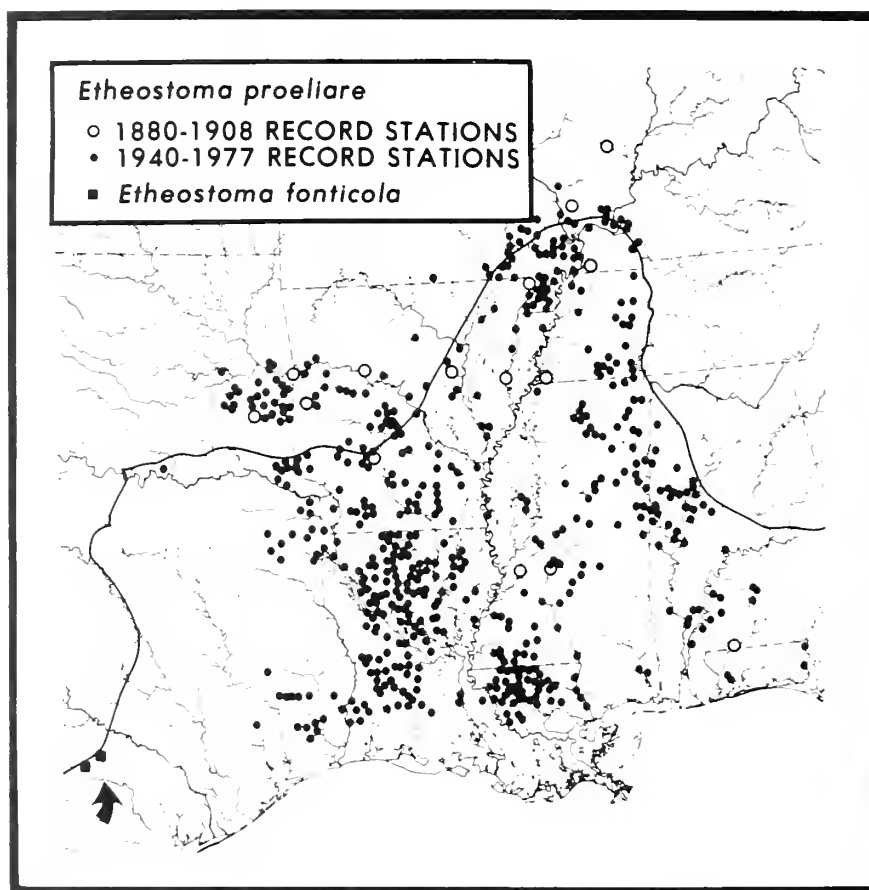
Order Perciformes
Family Percidae

TYPE LOCALITY: San Marcos River, just below mouth of Blanco River, TX (Jordan and Gilbert 1886. Proc. U.S. Natl. Mus. [1887] 9:1-25).

SYSTEMATICS: Subgenus *Microperca*. Closest relatives *E. proeliare* and *E. microperca*; of these two, *E. proeliare* is closest ally (Burr 1978. Bull. Ala. Mus. Nat. Hist.: 4:1-53).



TX: Hays Co., San Marcos River, male. 29 mm SL (INHS).



DISTRIBUTION AND HABITAT: Known only from San Marcos River at San Marcos, TX. Formerly occurred in Comal River at New Braunfels, TX. Last reported from Comal Springs in 1954, but reintroduced in 1975 by Schenck and Whiteside (1976. Copeia:697-703). Abundant in San Marcos Springs, in areas where vegetation grows close to substrate and water is clear, warm (21-23 °C) and quiet.

ADULT SIZE: 23-35 mm SL.

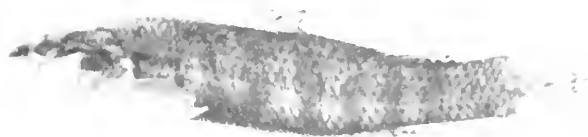
BIOLOGY: Strawn (1955. Aquarium J. 26: 408-09, 411-12; 1956. Aquarium J. 27:11, 13-14, 17, 31-32) observed spawning behavior. Schenck and Whiteside (1976) made recent population estimates. Food habits and feeding behavior analyzed by Schenck and Whiteside (1977a. Southwest. Nat. 21: 487-92). Fecundity and other reproductive characteristics studied by Schenck and Whiteside (1977b. Am. Midl. Nat. 98:365-75).
Compiler: B. M. Burr, August 1978.

Etheostoma fricksium Hildebrand
Savannah darter

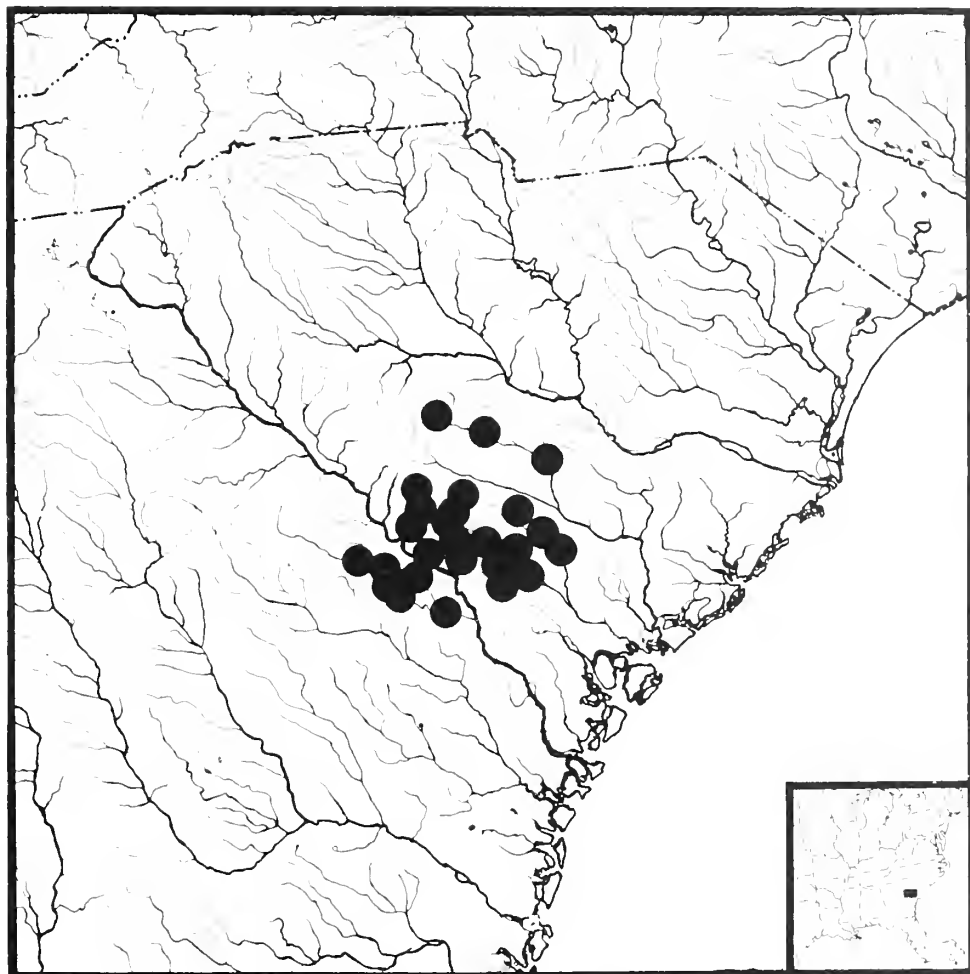
Order Perciformes
Family Percidae

TYPE LOCALITY: Creek on Sanitary Dairy Farm near Augusta, Richmond Co., GA (Hildebrand 1923. Bull. U.S. Bur. Fish. 39: 1-8).

SYSTEMATICS: Subgenus *Oligocephalus*. Richards (1963. Ph.D. diss., Cornell Univ.) reviewed species and Bailey and Richards (1963. Occas. Pap. Mus. Zool. Univ. Mich. 630:1-21) compared it with *E. hopkinsi*. Forms a natural species group with *E. mariac* and *E. parvipinne*.



GA: Richmond Co., Boggy Gut Creek, 62 mm SL (NCSM).



Map modified from Richards 1963

DISTRIBUTION AND HABITAT: Confined to Edisto, Combahee, Broad, and Savannah river drainages below Fall Line in SC and GA (Richards 1963). Rare to common in shallow creeks with moderate current. Usually taken over sand and gravel bottoms with vegetation often present.

BIOLOGY: Nothing has been published on this species.

ADULT SIZE: 30-62 mm SL.

Compiler: F. C. Rohde, May 1978.

Etheostoma fusiforme (Girard)
Swamp darter

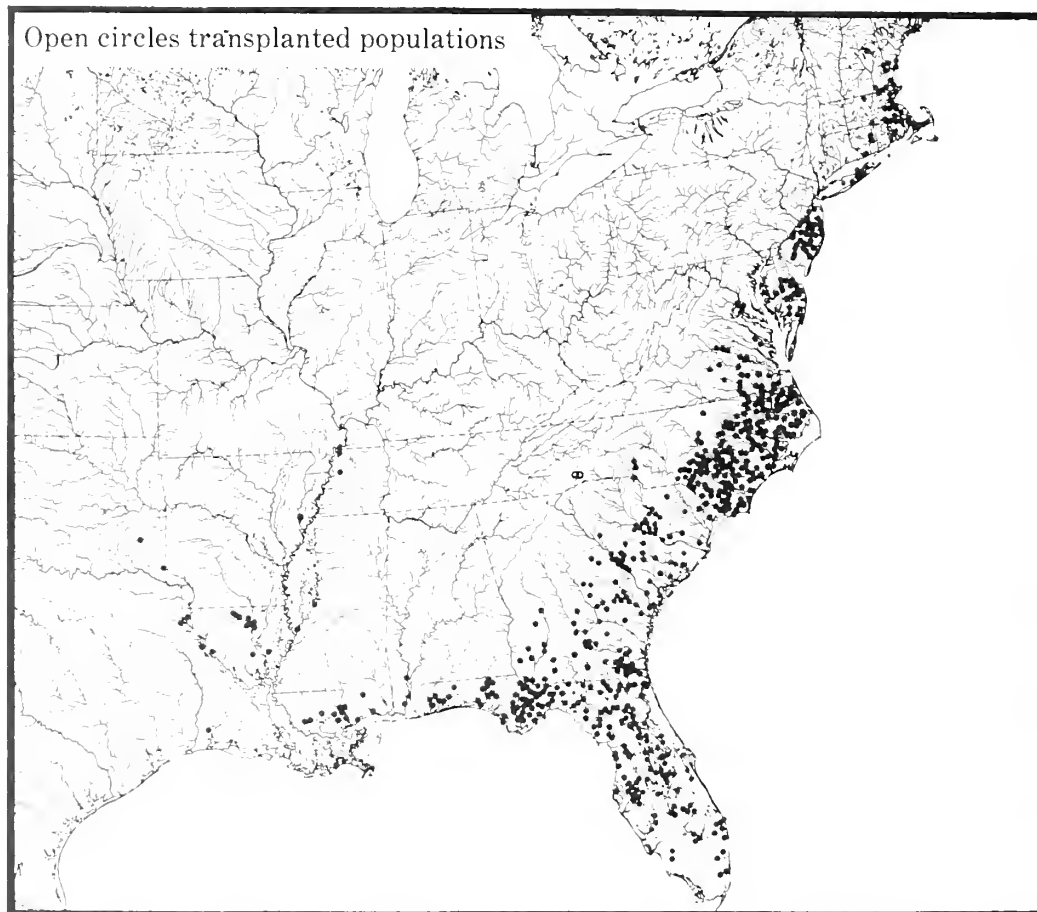
Order Perciformes
Family Percidae

TYPE LOCALITY: Tributary of Charles River at Framingham, MA (Girard 1854. Proc. Boston Soc. Nat. Hist. 5:40-42). Lectotype designated by Hubbs and Cannon (1935. Misc. Publ. Mus. Zool. Univ. Mich. 30:1-93).

SYSTEMATICS: Subgenus *Hololepis*, reviewed by Hubbs and Cannon (1935) and Collette (1962. Tulane Stud. Zool. 9:115-211). Two subspecies recognized, *E. f. fusiforme* and *E. f. barratti* which, prior to Collette's (1962) review, were recognized as species.



MD: Caroline Co., Smithville Lake, 39 mm TL (NCSM).



DISTRIBUTION AND HABITAT: Southeastern ME south along Atlantic slope, throughout peninsular FL; west along Gulf slope to TX and north to Reelfoot Lake, TN. Primarily on Coastal Plain; scattered records on Piedmont of southeast VA. Introduced to ponds in NC mountains. Nominate subspecies occurs south on Atlantic slope to Waccamaw River in southeastern NC, where replaced by *E. f. barratti*. In slow moving or stagnant waters of ponds, swamps, and sluggish streams, over bottom of mud and detritus. In warm waters reaching summer temperatures of 30-32°C or more, at depths of 76-102 mm (Collette 1962).

ADULT SIZE: ca. 30-50 mm SL.

BIOLOGY: Collette (1962) discussed feeding and spawning, noting variation in breeding times between two subspecies and various populations. *Etheostoma f. fusiforme* spawns in March and April; *E. f. barratti* specimens with tubercles taken from mid-December to mid-April (Ochlockonee population), October (Suwannee to Ochlockonee population), October (Suwannee to Ochlockonee population), and late May (Peedee population). Parasitized by glochidia (Harrington 1946. Ph.D. diss., Cornell Univ.).

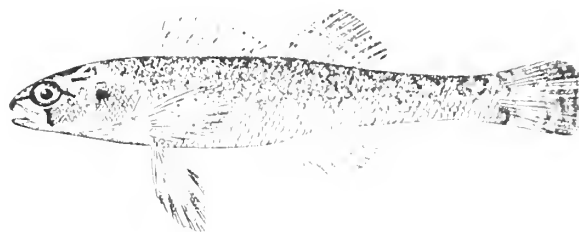
Compiler: A. Norden. February 1978.

Etheostoma gracile (Girard)
Slough darter

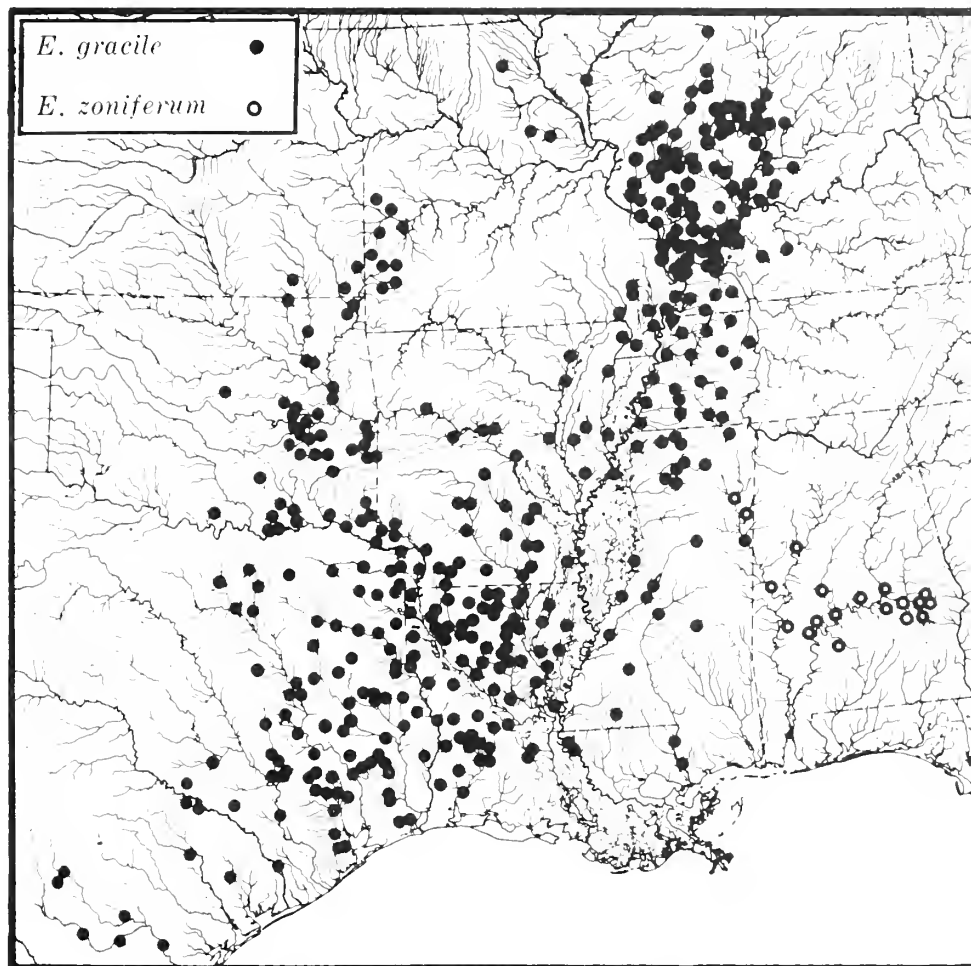
Order Perciformes
Family Percidae

TYPE LOCALITY: Rio Seco near Ft. Inge, TX (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:56-68). Lectotype selected by Hubbs and Cannon (1935. Misc. Publ. Mus. Zool. Univ. Mich. 30:1-93).

SYSTEMATICS: Subgenus *Hololepis*. Collette (1962. Tulane Stud. Zool. 9:115-211) reviewed species. Most closely related to *E. zoniferum*, which evolved from *E. gracile* stock.



AR: Arkadelphia, Washita River, 33 mm SL (Jordan and Evermann 1900).



Map modified from Collette 1962

DISTRIBUTION AND HABITAT: Gulf Coastal Plain from Tombigbee River, MS, west to Nueces River, TX; also found north along former Mississippi embayment to MO, IL, IN, and KY. Inhabits slow or moderately flowing waters with little or no aquatic plants and with predominant mud, silt, or sand substrate (Collette 1962).

BIOLOGY: Braasch and Smith (1967. Ill. Nat. Hist. Surv. Biol. Note 58:1-12) reviewed life history. Chironomids, copepods, and cladocerans are major food sources during winter, with mayflies becoming significant in spring. Spawns in late May and early June in IL.

ADULT SIZE: 35-50 mm TL.

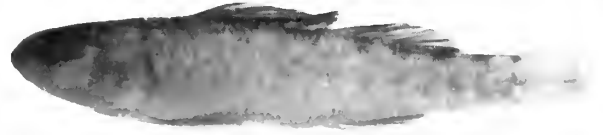
Compilers: C. H. Hocutt and J. R. Stauffer, Jr. September 1978.

Etheostoma grahami (Girard)
Rio Grande darter

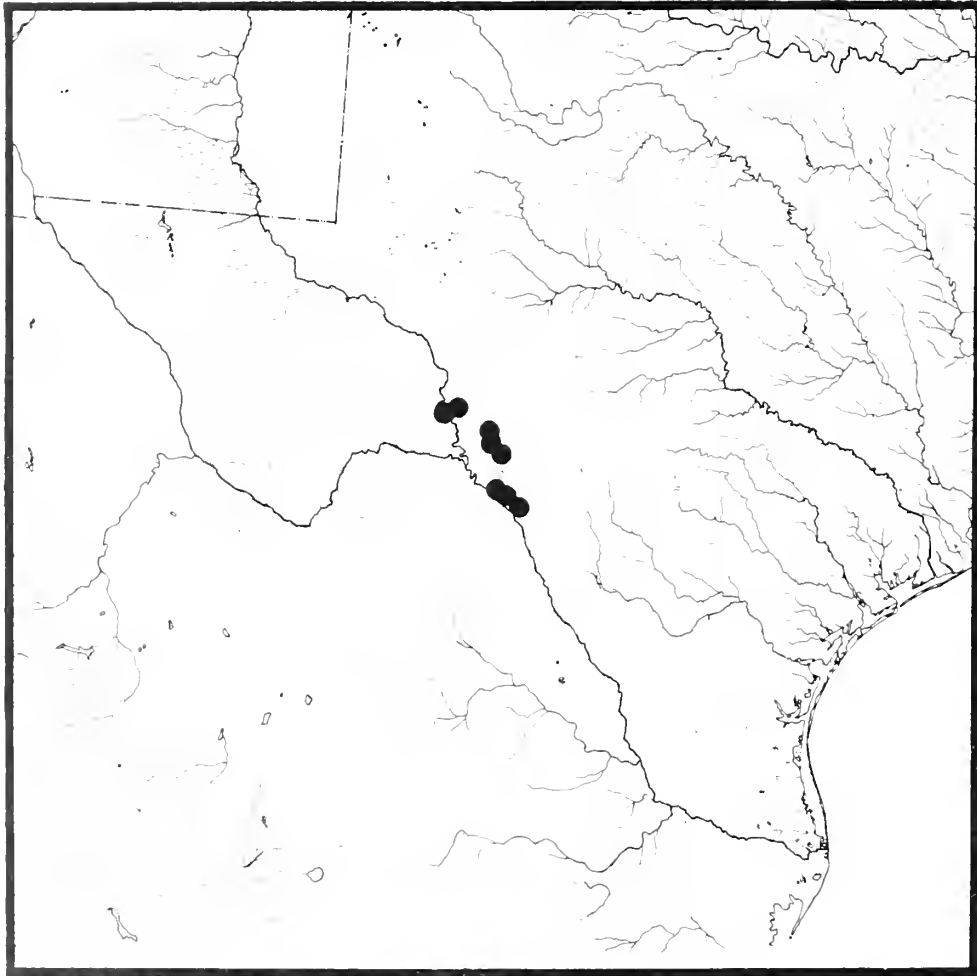
Order Perciformes
Family Percidae

TYPE LOCALITY: Devil's River near jet. with Rio Grande, Val Verde Co., TX (Girard 1859. Proc. Acad. Nat. Sci. Phila. 11: 100-04).

SYSTEMATICS: Subgenus *Oligocephalus*. Most similar to allopatric congener *E. lepidum*.



TX: Val Verde Co., Devil's River, 36 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Free-flowing portions of lower Pecos, Rio Grande (between Pecos River and Sycamore Creek), Devil's River, Dolan Creek, San Felipe Creek and Howard Springs near Pandale, Val Verde Co., TX; also in Rio Salado and Rio San Juan drainages, Nuevo Leon, Mexico.

ADULT SIZE: Approximately 30 mm SL.

BIOLOGY: Breeds late March to early June. Achieves maximum biomass by October and declines slightly until breeding season begins.

Compiler: H. L. Harrell. May 1978.

Etheostoma histrio (Jordan and
Gilbert)
Harlequin darter

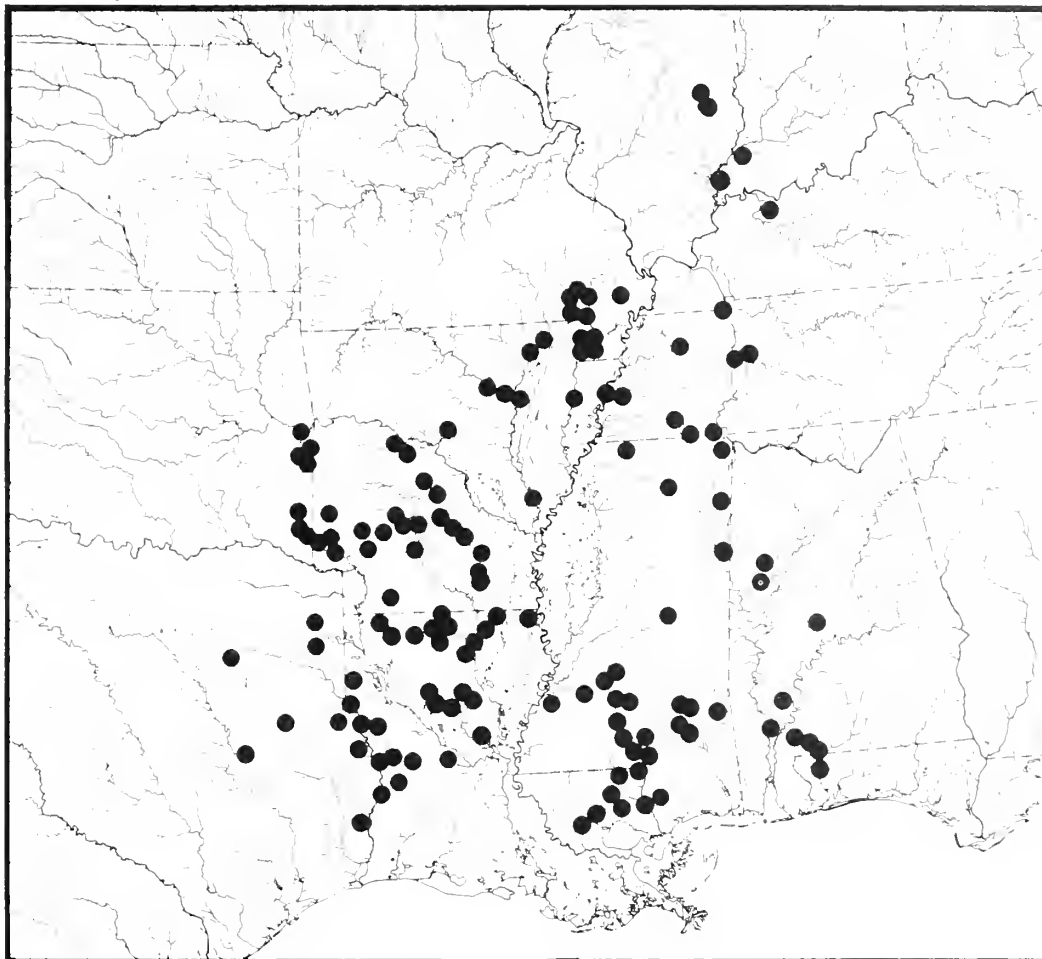
Order Perciformes
Family Percidae

TYPE LOCALITY: Saline River at Benton, AR; Washita River at Arkadelphia; and Poteau River, OK, w of Hackett City, AR (Jordan and Gilbert in Gilbert 1887. Proc. U.S. Natl. Mus. 10:47-64). Lectotype designation Poteau River, OK, w of Hackett City, AR, by Collette and Knapp (1967. Proc. U.S. Natl. Mus. 119:1-88).

SYSTEMATICS: Subgenus *Etheostoma*. Reviewed by Tsai (1968. Copeia: 178-81), who considered it most closely related to *E. zonale* and *E. rupestre*.



LA: Lincoln Parrish, Ouachita River system, 45 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Distributed widely in lower Mississippi River and adjacent Gulf Coast drainages. Reaches northern limit of range in Embarras River (tributary of Wabash River). Has been collected in following habitats: sluggish streams over mud bottoms; riffle areas over gravel, sand, or mud substrate; and in swift, turbid water over shaly rocks. Discussion of habitat in TX and OK by Hubbs and Pigg (1972. Copeia: 193-94) who always found it behind obstructions in heavy detritus. Once con-

sidered rare, but recently found to be more common than previously thought, particularly in more centralized southern localities.

ADULT SIZE: 38-69 mm TL.

BIOLOGY: Adults in spawning condition collected in February (Pflieger 1975. *The Fishes of Missouri*).

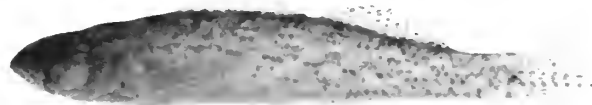
Compiler: C. H. Hocutt. June 1978.

Etheostoma hopkinsi (Fowler)
Christmas darter

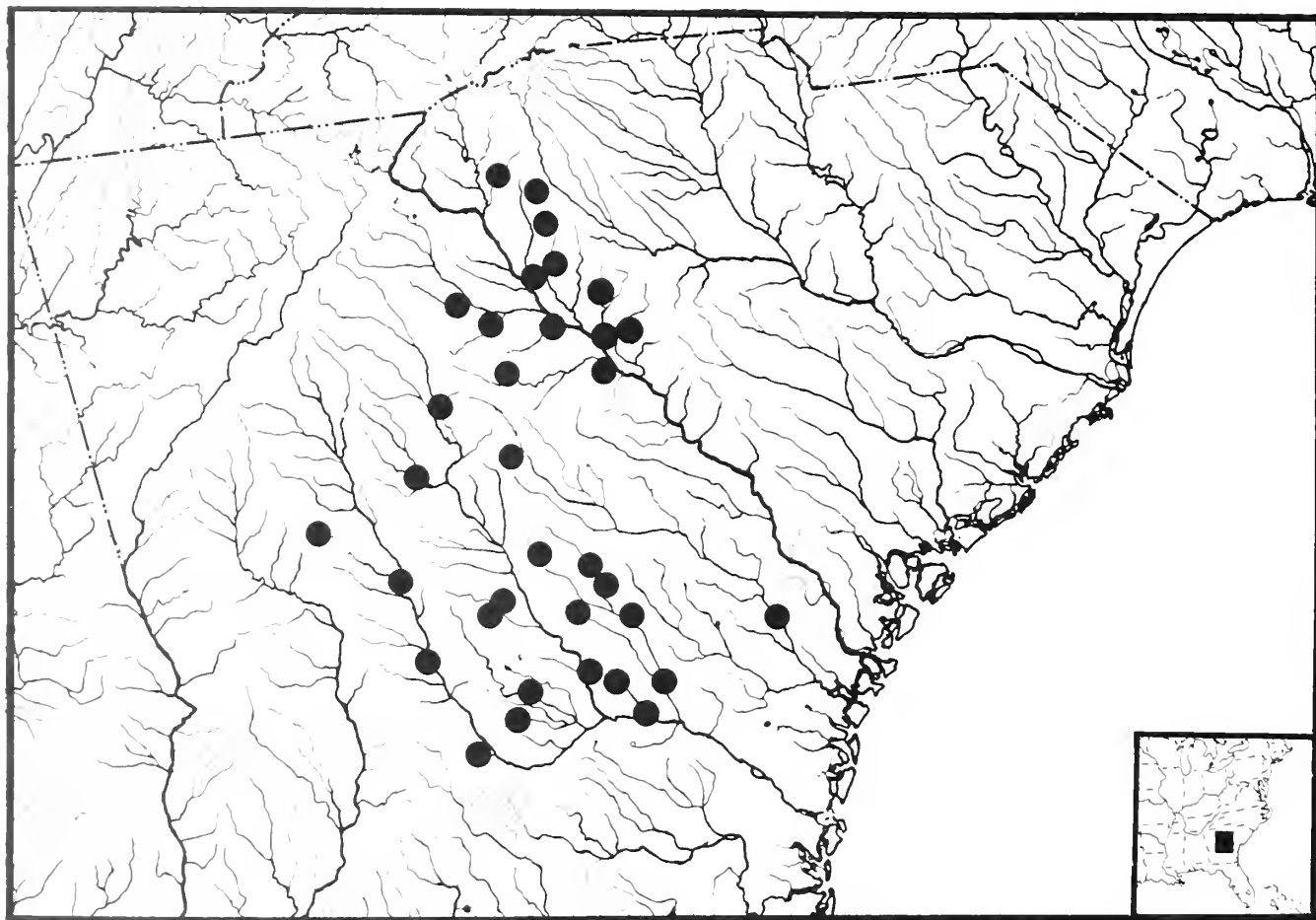
Order Perciformes
Family Percidae

TYPE LOCALITY: Osewitchee Springs, 22.4 km n of Fitzgerald, Wilcox Co., GA (Fowler 1945. Acad. Nat. Sci. Phila. Monogr. 7:1-408).

SYSTEMATICS: Subgenus *Oligocephalus*. Bailey and Richards (1963. Occas. Pap. Mus. Zool. Univ. Mich. 630:1-21) reviewed species and recognized two subspecies: *E. h. hopkinsi* and *E. h. binotatum*. Apparently closest relationships are to western species *E. swaini* and *E. asprigene*.



GA: Wilcox Co., Osewitchee Springs, 52 mm SL (NCSM).



Map modified from Bailey and Richards 1963

DISTRIBUTION AND HABITAT: *E. h. hopkinsi* is in Altamaha and Ogeechee river drainages, GA, above and below the Fall Line. *E. h. binotatum* occurs in Savannah River drainage, GA and SC, above and below the Fall Line. In small to medium-sized streams, occasionally in springs. May be rather common in preferred habitat.

ADULT SIZE: 30-60 mm SL.

BIOLOGY: Nothing has been published on this species.

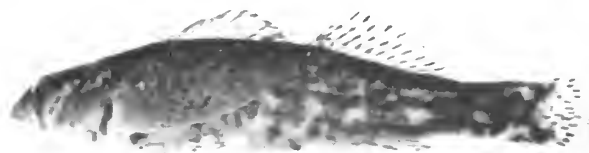
Compiler: F. C. Rohde, May 1978.

Etheostoma inscriptum (Jordan
and Brayton)
Turquoise darter

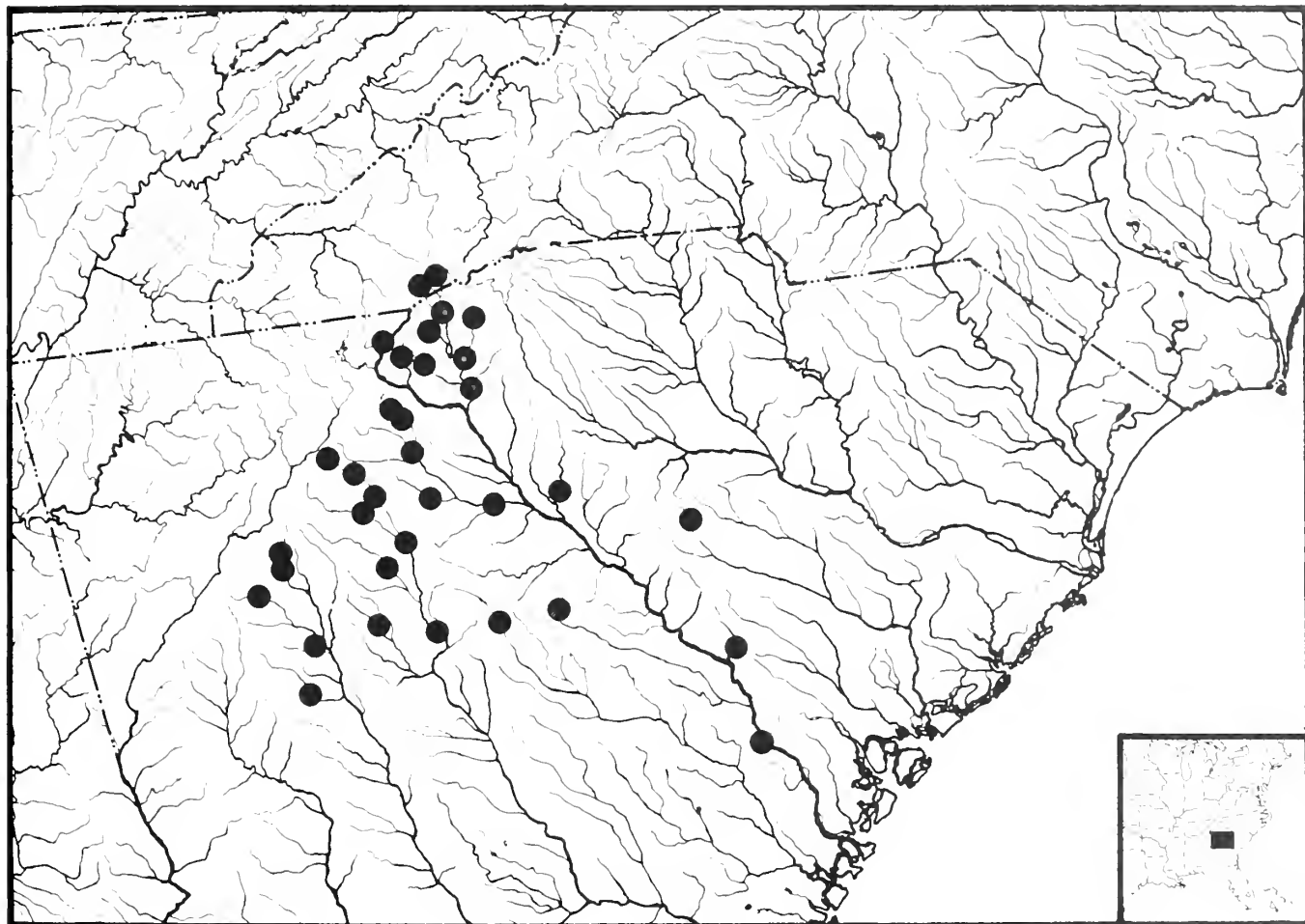
Order Perciformes
Family Percidae

TYPE LOCALITY: Oconee River at Sulphur Springs, Hall Co., GA (Jordan and Brayton 1878. U.S. Natl. Mus. Bull. 12-1-95).

SYSTEMATICS: Subgenus *Etheostoma*. Member of *E. thalassinum* species group with *E. swannanoa* (Richards 1966. Copeia: 823-38).



SC: Edgefield-McCormick cos.,
Turkey Creek (NCSM).



DISTRIBUTION AND HABITAT: Common in medium-sized Piedmont and lower Blue Ridge streams of Altamaha and Savannah drainages, NC, SC, and GA, in unvegetated rubble-bedrock riffle areas with moderate to strong current. Uncommon in upper Ogeechee and Edisto drainages; rarely on Coastal Plain.

ADULT SIZE: 55-65 mm SL.

BIOLOGY: No published information.

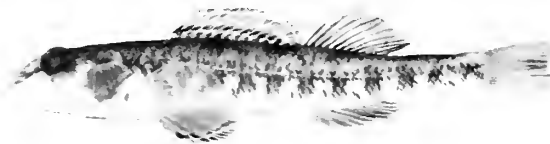
Compiler: W. C. Starnes. May 1978.

Etheostoma jessiae (Jordan and
Brayton)
Blueside darter

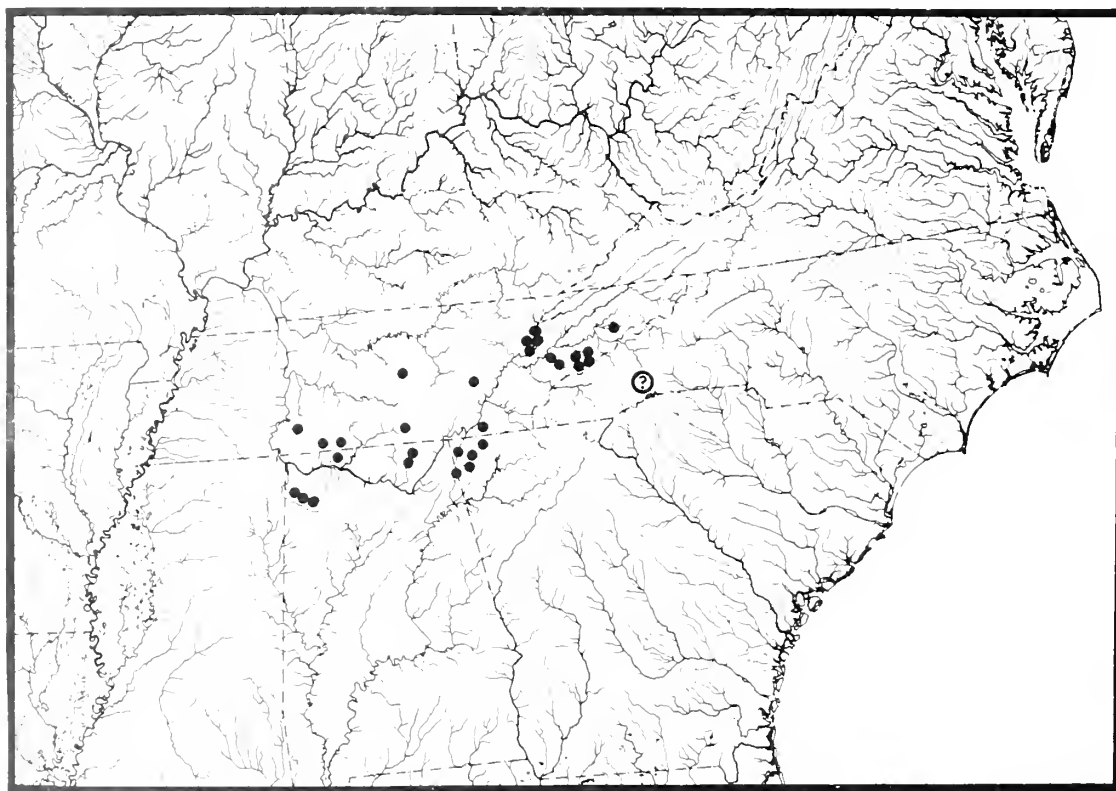
Order Perciformes
Family Percidae

TYPE LOCALITY: Chickamauga River, tributary of Tennessee River, at Ringgold, GA (Jordan 1878. U. S. Natl. Mus. Bull. 12: 1-95.)

SYSTEMATICS: Subgenus *Doration* (Howell 1968. Ph.D. diss., Univ. Alabama). Very closely related to *E. stigmaeum* and *E. mediae*. These, along with two undescribed species from Cumberland River drainage, form close-knit species complex. Hybridizes with *E. stigmaeum* in Little Bear Creek, Franklin Co., AL. Stones River population may represent undescribed sibling form.



AL: Jackson Co., Hurricane Creek, male, 43 mm SL (W. M. Howell).



DISTRIBUTION AND HABITAT: Typical race in Tennessee River drainage of AL, GA, TN, and NC. Cumberland River drainage race atypical and represented by only 30 specimens from single collection from Stones River near Murfreesboro, TN (CU 46558). Generally in small to relatively moderate-sized creeks with sand and gravel substrate. Prefers streams with moderate to swift flow. Usually distributed throughout streams in riffles and pools.

ADULT SIZE: 36-48 mm SL.

BIOLOGY: Little known. Reproductive behavior and ecology presumably similar to that described for *E. stigmaeum* by Winn (1958a. Am. Midl. Nat. 59:190-212; 1958b. Ecol. Monogr. 28:155-91). From examination of preserved material, appears that *E. jessiae* spawns in March and April.

Compiler: W. M. Howell. October 1978.

Etheostoma jordani Gilbert
Greenbreast darter

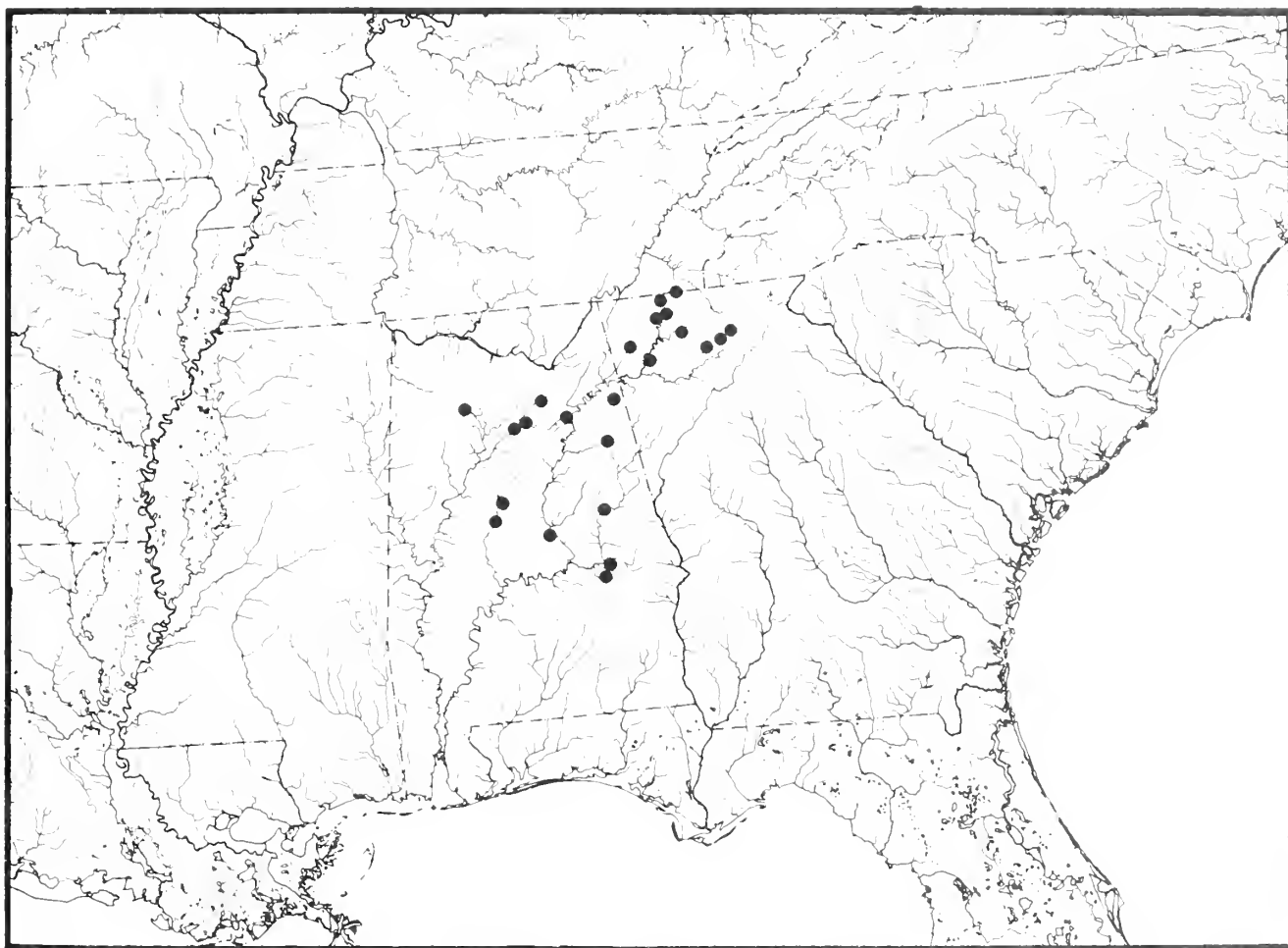
Order Perciformes
Family Percidae

TYPE LOCALITY: Choccolo Creek, tributary to Coosa River at Oxford, Calhoun Co., AL (Gilbert 1891. Bull. U. S. Fish. Comm. 9:143-59). Lectotype designated by Collette and Knapp (1967. Proc. U. S. Natl. Mus. 119:1-88).

SYSTEMATICS: Subgenus *Nothonotus*. Closest relatives considered uncertain by Zorach (1969. Am. Midl. Nat. 81:412-34), who reviewed species.



AL: Cleburne Co., Coosa River system, male, 52 mm SL (Smith-Vaniz 1968).



Map modified from Zorach 1969

DISTRIBUTION AND HABITAT: Confined to Coosa, Tallapoosa, Cahaba, and Black Warrior systems of Mobile Bay drainage, AL, GA, and TN (Zorach 1969). Often common. Inhabitant of clean, fast riffles over gravel and rubble.

BIOLOGY: Little known. Zorach (1969) discussed sexual dimorphism and coloration.

ADULT SIZE: 40-60 mm SL.

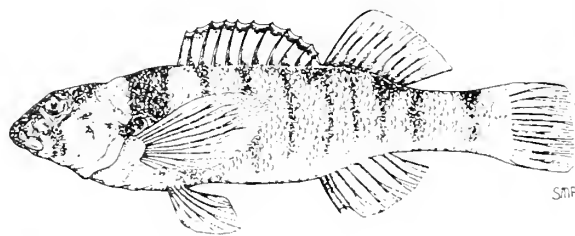
Compiler: C. H. Hocutt. September 1978.

Etheostoma juliae Meek
Yoke darter

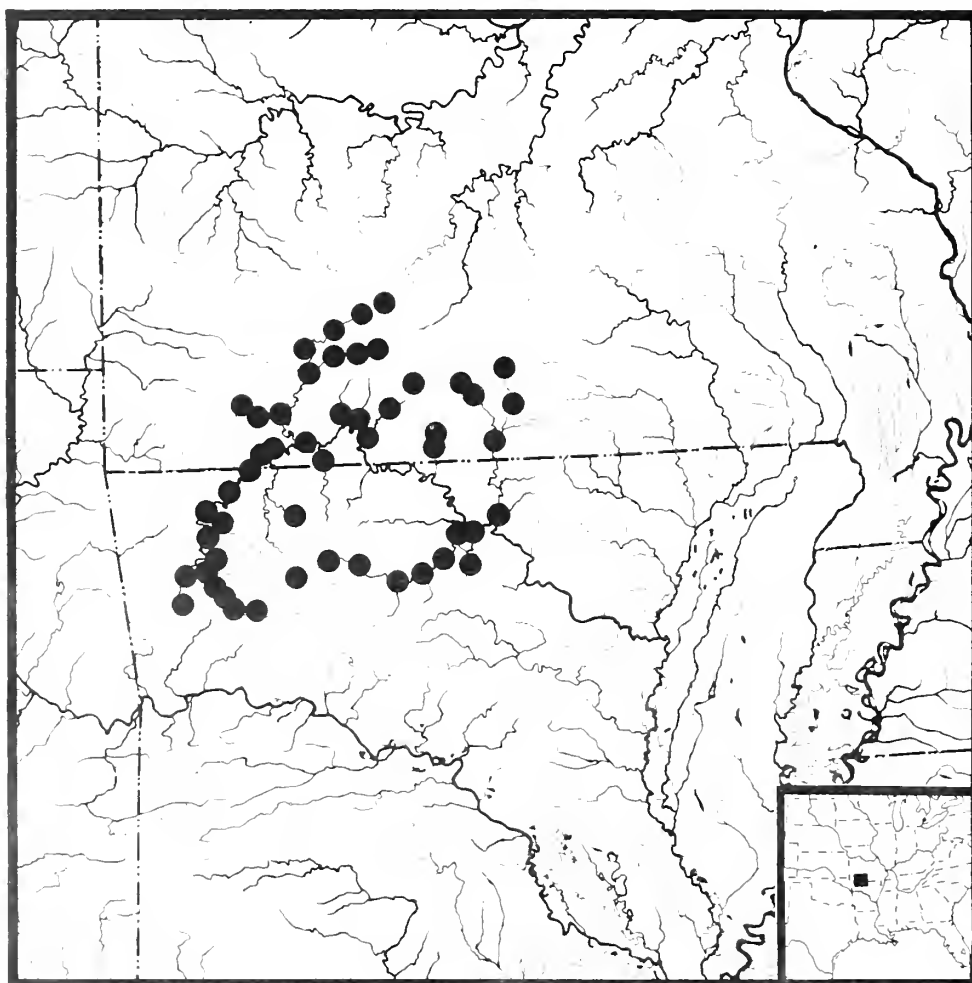
Order Perciformes
Family Percidae

TYPE LOCALITY: James River near Springfield, Greene Co., MO (Meek 1891. Bull. U. S. Fish Comm. 9:113-41).

SYSTEMATICS: Subgenus *Oligocephalus* (Bailey and Gosline 1955. Misc. Publ. Mus. Zool. Univ. Mich. 93:1-44). Possible close affinity with subgenus *Nothonotus* (Zorach 1972. Copeia:427-47). Variation in vertebral numbers studied by Hill (1968. Southwest. Nat. 13:175-91).



(Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: Upper White River drainage of MO and AR, downstream to and including Buffalo and North Fork rivers. Formerly common in most principal streams, but now absent from impounded sections of North Fork and White rivers. Abundant on coarse-gravel and rubble riffles of medium to large Ozark streams.

BIOLOGY: Largely unknown. Spawning occurs on swift riffles in May (Pflieger 1975. *The Fishes of Missouri*). Breeding adults are nontuberculate (Collette 1965. Proc. U. S. Natl. Mus. 117:567-614).

ADULT SIZE: 43-63 mm SL.

Compiler: W. L. Pflieger. April 1978.

Etheostoma kanauchae (Raney)
Kanawha darter

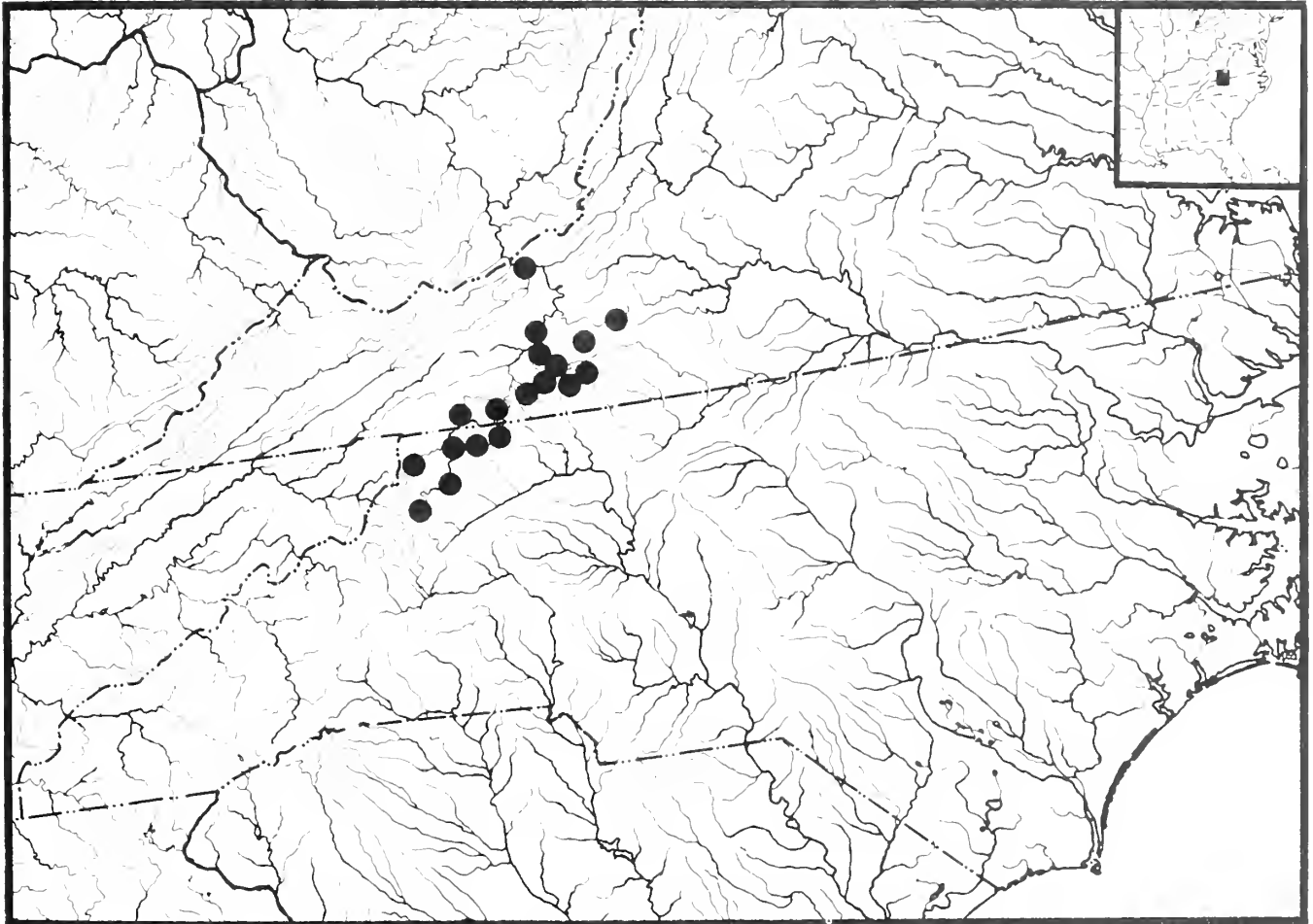
Order Perciformes
Family Percidae

TYPE LOCALITY: North Fork New River on state route 16 at Crumpler, Ashe Co., NC (Raney 1941. Occas. Pap. Mus. Zool. Univ. Mich. 434:1-16).



SYSTEMATICS: Subgenus *Etheostoma*. Member of *E. variatum* group; most closely related to *E. osburni*. Hubbs and Black (1940. Occas. Pap. Mus. Zool. Univ. Mich. 416:1-30) reviewed complex prior to description of *E. kanauchae*.

VA: Carroll Co., Little Reed Island Creek, 65 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to and widely distributed in upper New (upper Kanawha) River and tributaries, VA and NC. One disjunct record from main-channel New River, near Eggleston, VA. Distribution may be limited by water hardness (Ross and Perkins 1959. Va. Agric. Exp. Stn. Tech. Bull. No. 145:1-35), and competitive interaction with *E. osburni*. Uncommon or rare at some localities, but often common to abundant. Most common in medium-sized streams. Prefers riffles with clean gravel to rocky substrates.

ADULT SIZE: 55-75 mm SL.

BIOLOGY: Unknown. Spawns in spring based on nuptial color and tubercle development.

Compilers: C. H. Hocutt, R. E. Jenkins, J. R. Stauffer, Jr. October 1978.

Etheostoma kennicotti (Putnam)
Stripetail darter

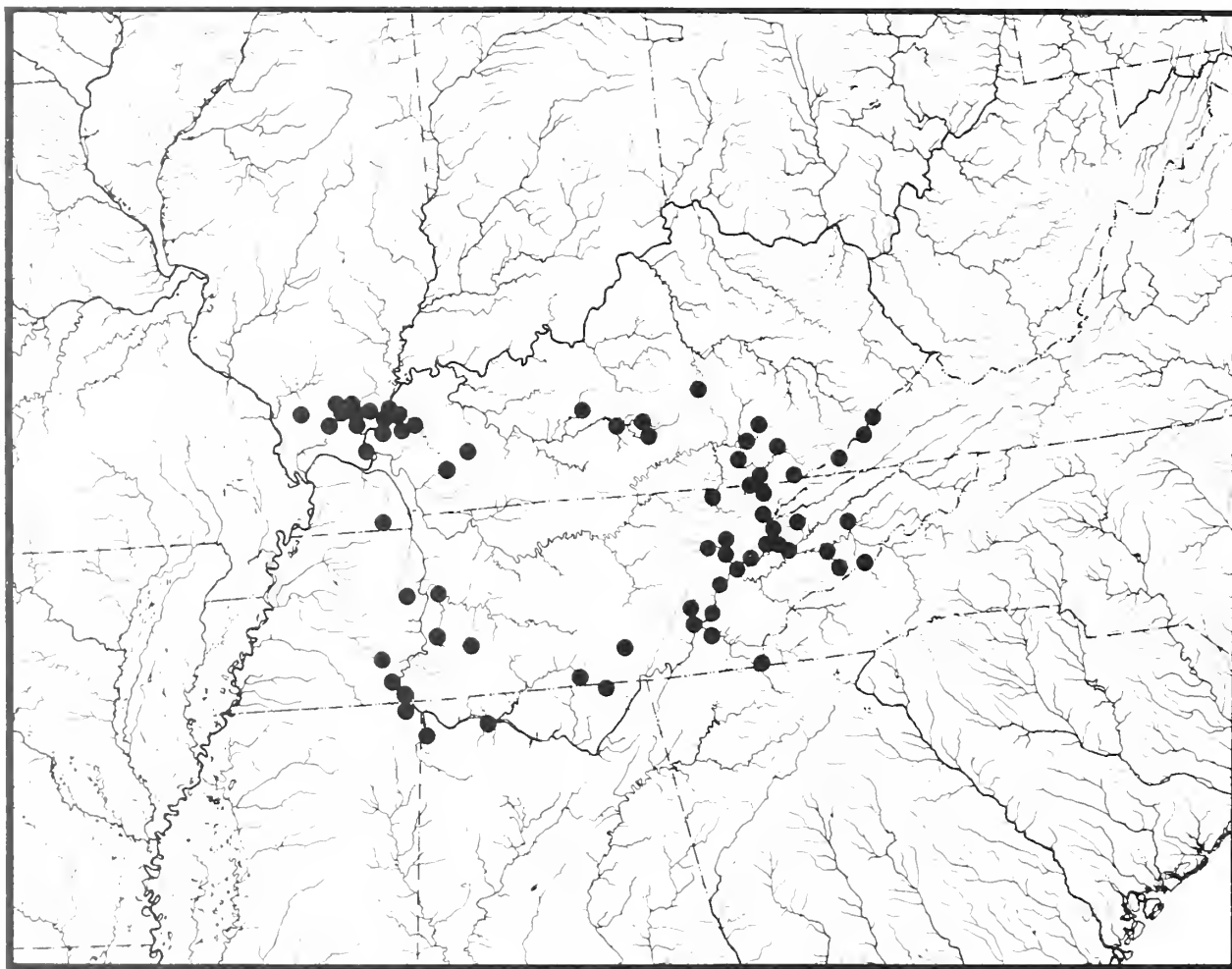
Order Perciformes
Family Percidae

TYPE LOCALITY: A rocky brook, Union Co., IL (Putnam 1863. Bull. Mus. Comp. Zool. 1:2-16; Smith and Page 1975. Copeia: 777-78).

SYSTEMATICS: Subgenus *Catonotus*. Closest relative is *E. flabellare*. Systematics and geographic variation discussed by Page and Smith (1976. Copeia:532-41).



IL: Hardin Co., Big Creek,
male, 47 mm SL (INHS).



Map modified from Page and Smith 1976

DISTRIBUTION AND HABITAT: Tributaries of Ohio River in southern IL and northwestern KY; Tennessee, upper Cumberland, and Green river drainages in KY, TN, GA, AL, and MS. Locally common but sporadically distributed. In slab-rock pools of small to large streams.

BIOLOGY: Page (1975. Ill. Nat. Hist. Surv. Biol. Notes 93:1-15) discussed life history in Big Creek, IL. Spawns early April to late May on undersides of slab rocks. Oldest specimen examined estimated to be slightly less than three years old. Diet mostly immature insects and crustaceans. Page and Schemske (1978. Copeia:406-12) examined competition with other *Catonotus*.

ADULT SIZE: 30-69 mm SL.

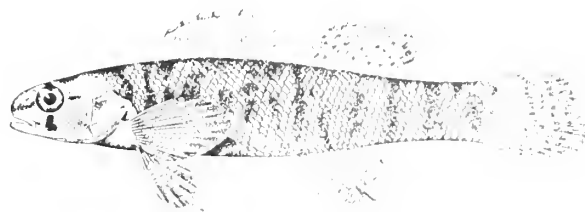
Compiler: L. M. Page. December 1978.

Etheostoma lepidum (Baird and Girard)
Greenthroat darter

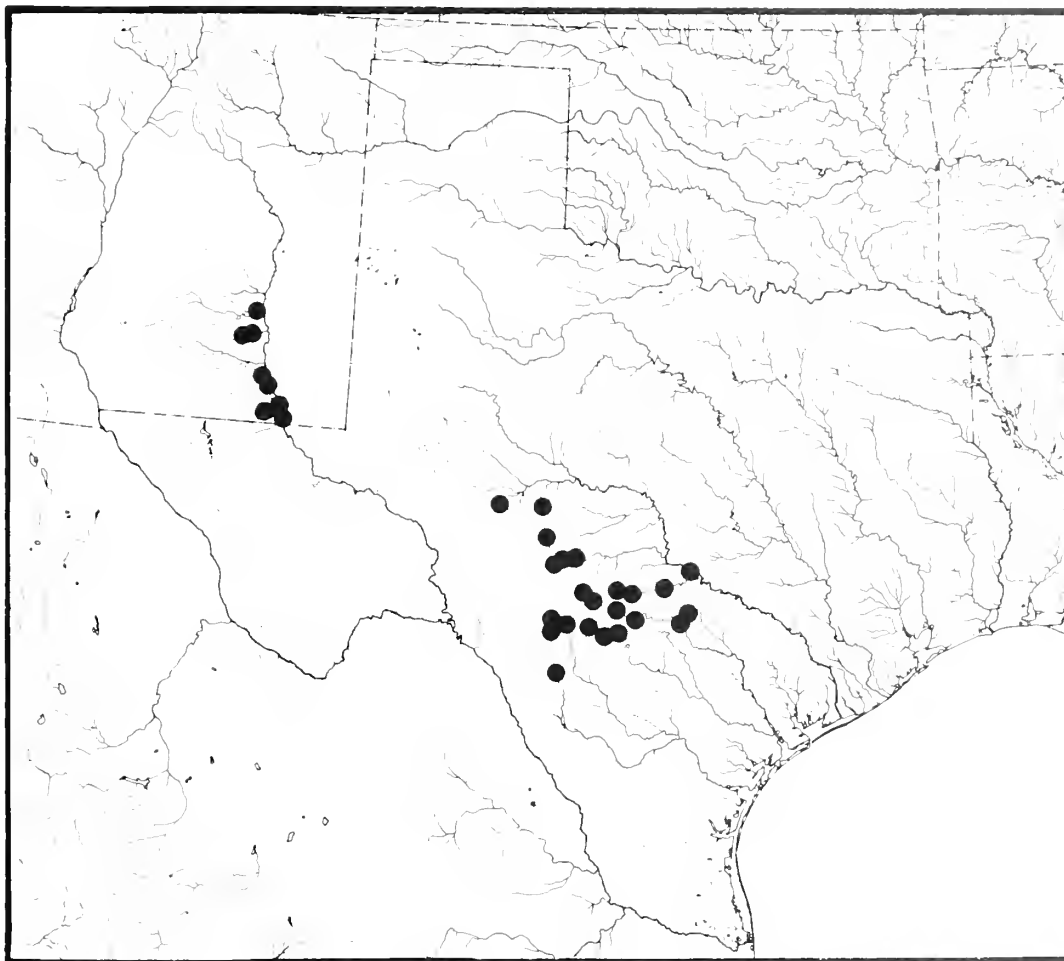
Order Perciformes
Family Percidae

TYPE LOCALITY: Rio Leona at Uvalde, Uvalde Co., TX (Baird and Girard 1853. Proc. Acad. Nat. Sci. Phila. 6:387-90).

SYSTEMATICS: Subgenus *Oligocephalus*. Most closely related to allopatric *E. grahami* of lower Pecos River and closely adjacent area. Hubbs and Echelle (1972. Symposium on Rare and Endangered Wildlife of Southwestern United States: 147-67) discussed taxonomic status of Pecos system population.



TX: Comal Spring, New Braunfels (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Edwards Plateau of central TX (Nueces to Colorado river drainages) and Pecos River system in southeast NM. Occurs in variety of non-turbid stream habitats with substrates from bedrock to silt covered. Also in heavily vegetated springs and sinkholes. Most common in riffle areas with rocky, plant-covered substrates (Hubbs and Echelle 1972).

ADULT SIZE: 23-41 mm SL, 64 mm SL maximum.

BIOLOGY: Strawn (1955-1956. Aquarium J. 26:408-12; 27:11-17, 31-32) treated aspects of ecology and reproduction. Hubbs (1961. Copeia: 198-200) discussed differences in incubation period of two populations and effects of light and temperature on fecundity. Hubbs et al. (1969. Am. Midl. Nat. 81:182-88) discussed developmental temperature tolerance. Hubbs and Echelle (1972) reported reasons for decline in distribution.

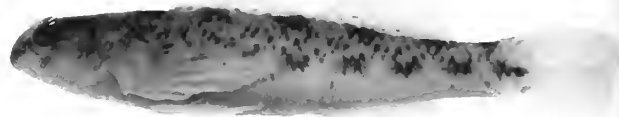
Compiler: S. P. Platania. January 1979.

Etheostoma longimanum Jordan
Longfin darter

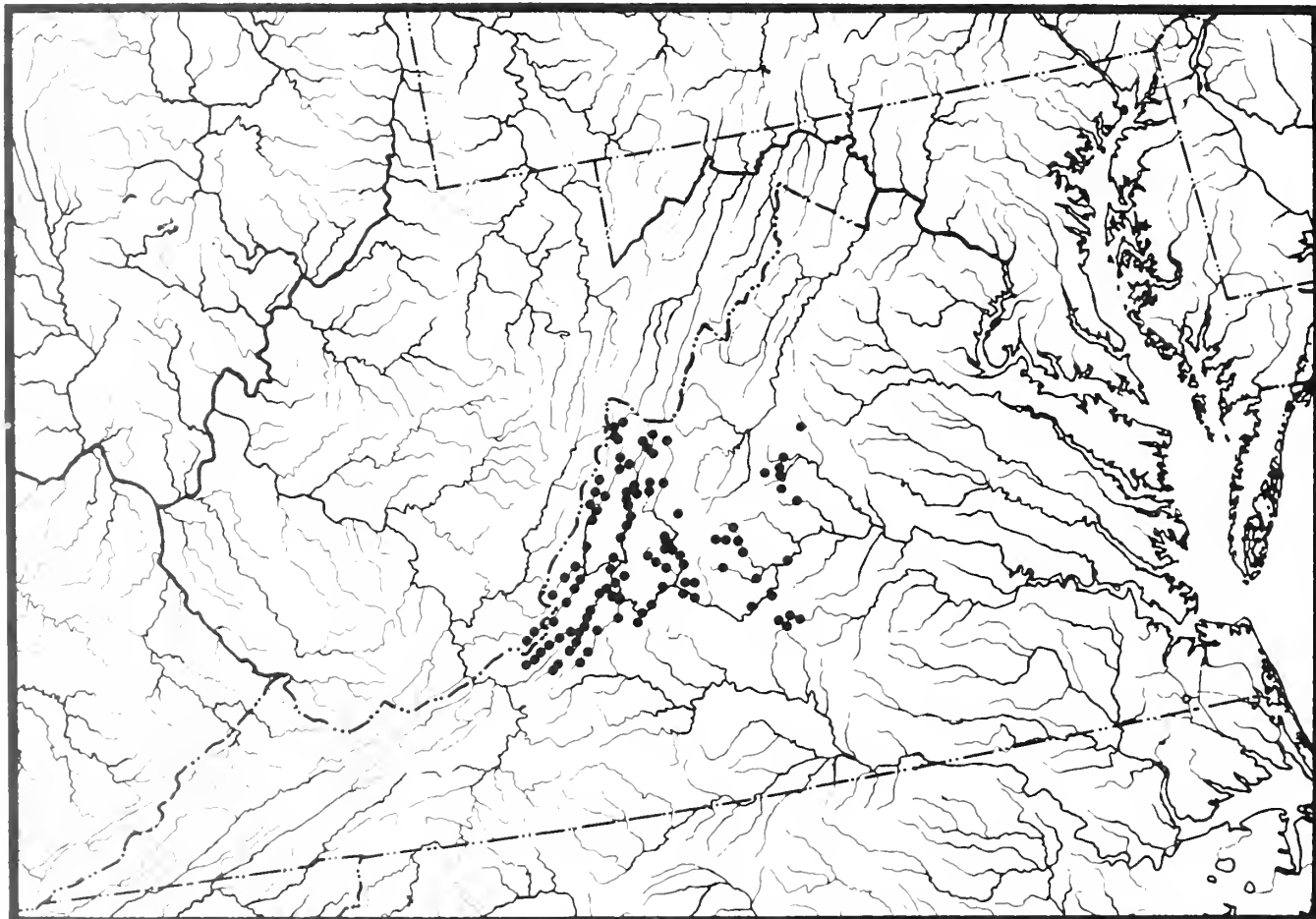
Order Perciformes
Family Percidae

TYPE LOCALITY: Tributary (unnamed) of James River, VA (Jordan 1889. Proc. Acad. Nat. Sci. Phila. [1888] 40:179). Lectotype designated by Cole (in Collette and Knapp 1967. Proc. U.S. Natl. Mus. 119:1-88).

SYSTEMATICS: Subgenus *Boleosoma*. Mostly closely related to, and well differentiated from, its geminate of adjacent Roanoke River drainage, *E. podostemone* (Miles 1964. M. S. thesis, Virginia Polytech. Inst. State Univ.; Cole in Holt [ed.] 1972. Va. Polytech. Inst. State Univ. Res. Div. Monogr. 4:119-38).



VA: Botetourt Co., Catawba Creek, 47 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to upper James River drainage, VA and WV. Occurs throughout Ridge and Valley and Blue Ridge provinces. Occupies uplands of extreme upper Piedmont province in James system; isolated population in upper section of Ap-pamattox River system. Inhabits runs and riffles of gravel to boulder, in small to large, cool to warm, typically clear streams. Often common. Another member of *Bolecosma*, *E. nigrum*, occupies slower currents in same streams.

ADULT SIZE: 35-70 mm SL.

BIOLOGY: Longevity normally two to three years. Some males and females mature in first spring following year of hatching (Raney and Lachner 1943. Am. Midl. Nat. 29:229-38). Based on aquarium observations, spawns on underside of nest cover (Voiers, pers. comm.; 1964. Abst. 45th Ann. ASIH). Probably spawns April and May, based on nuptial color and gonadal development.

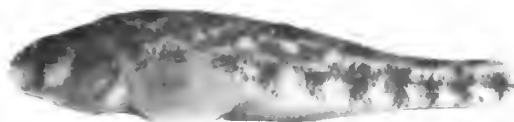
Compiler: R. E. Jenkins. January 1979.

Etheostoma luteovinctum
Gilbert and Swain
Redband darter

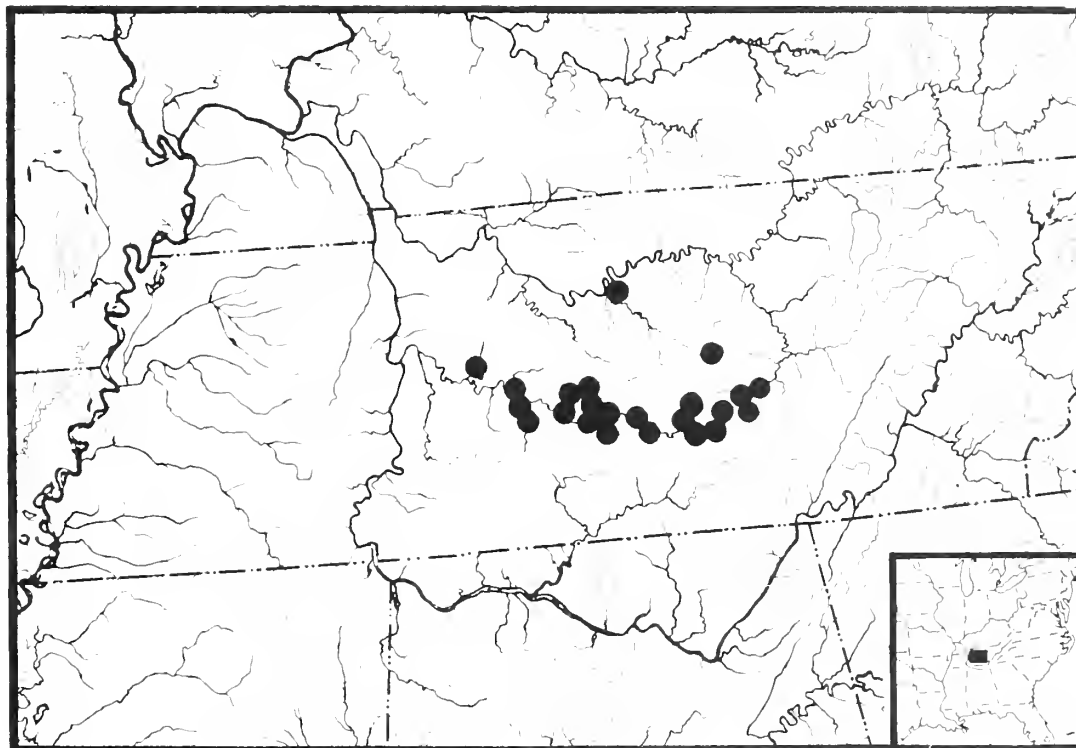
Order Perciformes
Family Percidae

TYPE LOCALITY: Stone(s) River near Nashville, TN (Gilbert 1887. Proc. U.S. Natl. Mus. 10:47-64).

SYSTEMATICS: Subgenus *Oligocephalus*. Probable affinities with *E. caeruleum*. No definitive systematic studies have been published.



TN: Bedford Co., Little Hurricane Creek, 55 mm SL (R. T. Bryant, Jr.).



DISTRIBUTION AND HABITAT: Confined to headwaters of Duck River (Tennessee drainage), and Caney Fork and Stones rivers (Cumberland drainage) of middle TN, where it occurs in springs, spring outflows, and small, clear, gravel bottom streams. Probably extirpated from type locality.

ADULT SIZE: 58 mm SL maximum

BIOLOGY: Unstudied.

Compiler: D. A. Etnier. June 1978.

Etheostoma maculatum Kirtland
Spotted darter

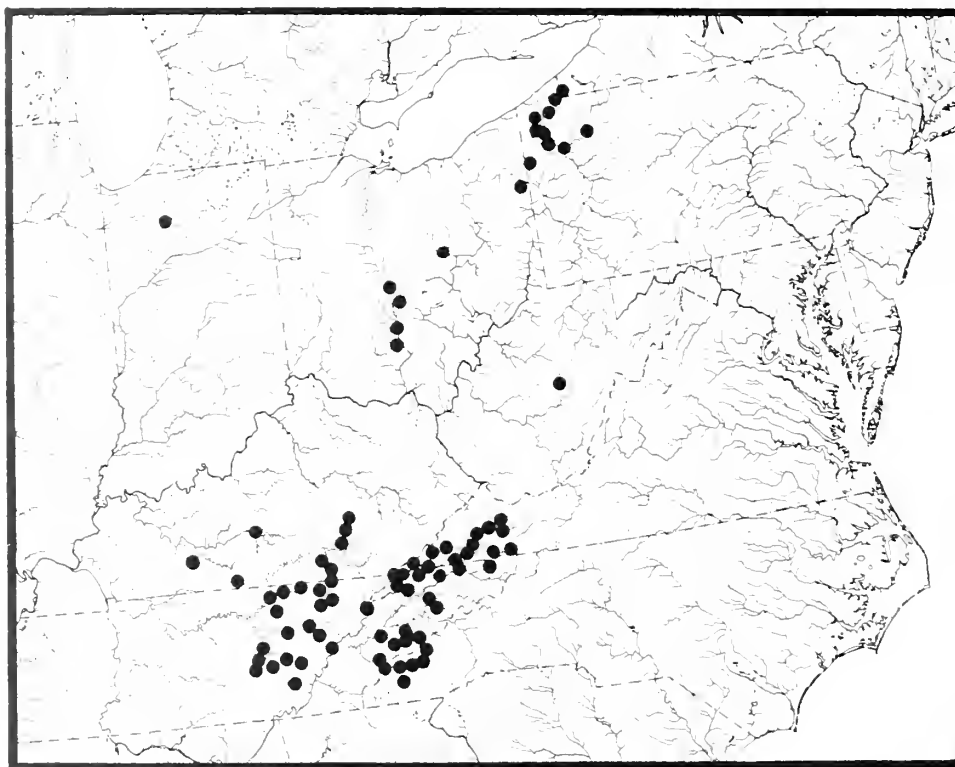
Order Perciformes
Family Percidae

TYPE LOCALITY: Mahoning River, OH
(Kirtland 1841. Boston J. Nat. Hist. 3:273-79).

SYSTEMATICS: Subgenus *Nothonotus*. Closest relatives are *E. aquali*, *E. microlepidum*, *E. moorei*, and *E. rubrum*. Three recognized subspecies: *E. m. maculatum*, *E. m. sanguifluum*, and *E. m. vulneratum* (Zorach and Raney 1967. Am. Midl. Nat. 77:296-322).



TN: Blount Co., Little River,
65 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Nominate subspecies with relict distribution pattern in Ohio River basin, from northwest PA, southwest NY, central OH, northcentral IN (probably extirpated), to KY. *E. m. sanguifluum* in Cumberland drainage from Caney Fork River upstream to Cumberland Falls. *E. m. vulneratum* in upper Tennessee drainage downstream to Little Tennessee River. Extant juvenile specimens from Elk River and Shoal Creek (middle Tennessee River drainage) are believed to represent distinct, and possibly extinct, taxon (or taxa) related to *E. maculatum* (Williams and Etnier 1978. Proc. Biol. Soc. Wash. 91:463-71). In large, clear streams and rivers among large rubble and boulder areas, either adjacent to or in swift deep riffles.

ADULT SIZE: 40-70 mm SL.

BIOLOGY: Spawns during midsummer, with about 50 eggs per spawning act attached to undersides of large rocks and typically guarded by a territorial male. Diet dominated by midge larvae (Chironomidae). (Raney and Lachner 1939. Copeia:157-65; Stiles 1972. Ph.D. diss., Univ. Tennessee).

Compiler: D. A. Etnier. June 1978.

Etheostoma mariae (Fowler)
Pinewoods darter

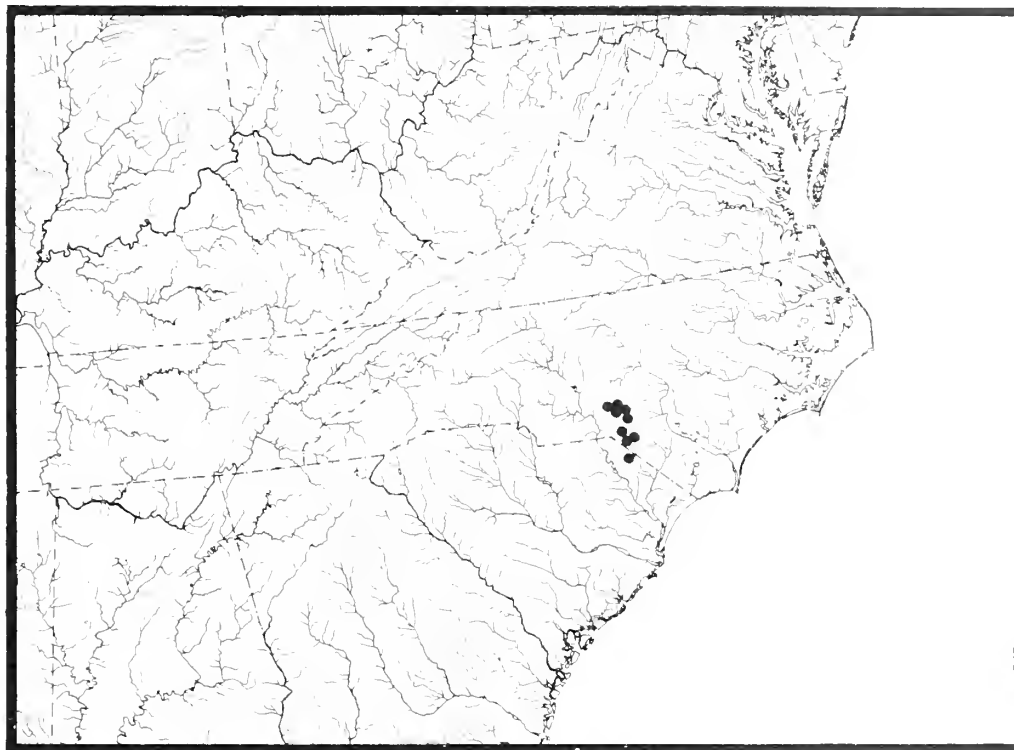
Order Perciformes
Family Percidae

TYPE LOCALITY: Tributary outlet of Watson's Lake, about 4.8 km w of Southern Pines, in eastern Moore Co., NC (Fowler 1947. Not. Nat. 191:1-3).

SYSTEMATICS: Subgenus *Oligocephalus*. Richards (1963. Ph.D. diss., Cornell Univ.) reviewed species. *Etheostoma parvipinne*, *E. fricksium*, and *E. mariae* seem to form natural species group within subgenus. *Etheostoma mariae* apparently derived from *E. fricksium* prototype and shows specialized features due to isolation.



NC: Moore Co., Deep Sandy Run Creek, 52 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Fowler's (1947) report of occurrence in Cape Fear River drainage in error. Confined to Carolina Sandhills area of Little Pee Dee River system in NC and SC around Fall Line, where it shows close distributional parallel with the cyprinid fish, *Semotilus lumbee*. Occasionally taken in vegetation. Moderately common in shallow streams with moderate current, usually over gravel riffles.

ADULT SIZE: 40-63 mm.

BIOLOGY: Nothing published.

Compiler: F. C. Rohde. May 1978.

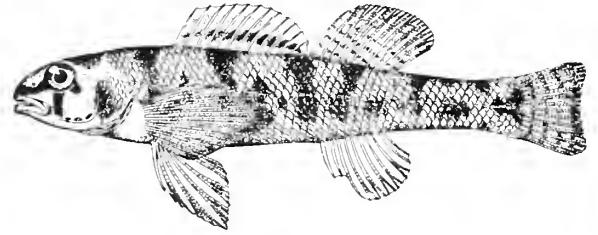
Etheostoma meadiae (Jordan and
Evermann)

No common name

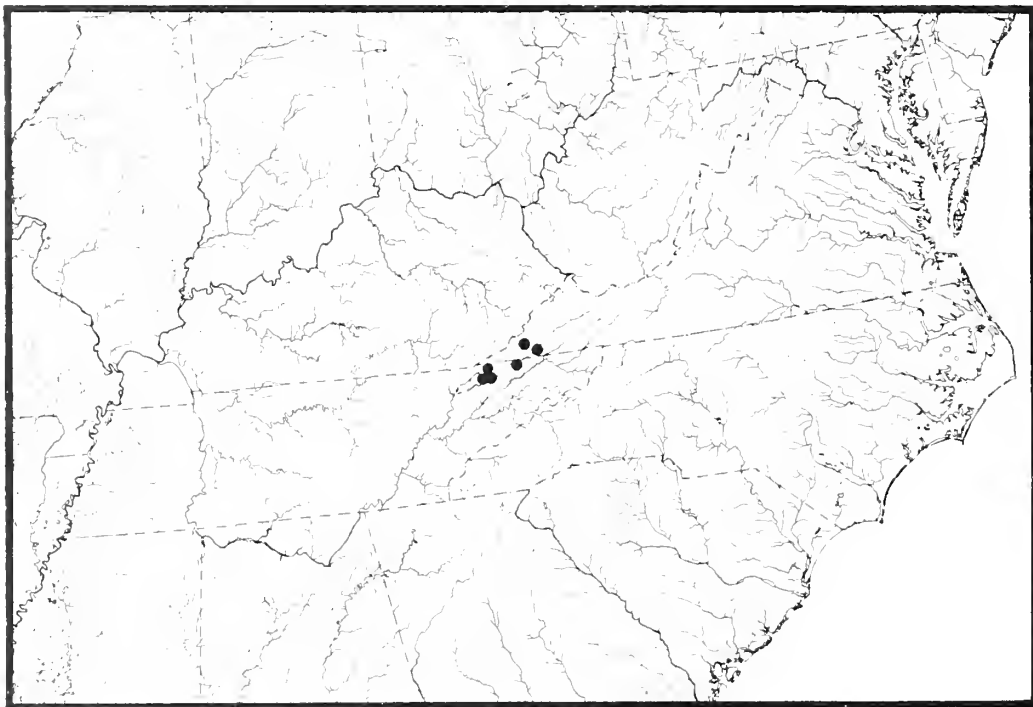
Order Perciformes
Family Percidae

TYPE LOCALITY: Indian Creek at Cumberland Gap, TN (Jordan and Evermann 1898. U.S. Natl. Mus. Bull. 47:2183-3136).

SYSTEMATICS: Subgenus *Doration* (Howell 1968. Ph.D. diss., Univ. Alabama). Originally considered by Howell (1968) to represent intergrade population between *E. jessiae* and *E. stigmaeum*. Closely allied to *E. jessiae*, *E. stigmaeum*, and two undescribed forms from Cumberland River drainage.



TN: Indian Creek, Cumberland Gap (Jordan and Evermann 1900).



Map modified from Howell 1968

DISTRIBUTION AND HABITAT: Upper Powell and Clinch river systems of Tennessee River drainage in VA and TN. Generally found in small to moderate-sized creeks with sand, gravel, and boulder substrate. Prefers streams with moderate to swift flow. Usually distributed throughout stream in both pools and riffles, but in VA not in swift riffles.

ADULT SIZE: 38-42 mm SL.

BIOLOGY: Little known. Spawning probably occurs late March through April, based upon presence of high breeding colors in males and ripe eggs in females during this time. Reproductive behavior and ecology presumably similar to that described for *E. stigmaeum* by Winn (1958a. Am. Midl. Nat. 59: 190-212; 1958b. Ecol. Monogr. 28:155-91).

Compiler: W. M. Howell. October 1978.

Etheostoma microlepidum Raney
and Zorach
Smallscale darter

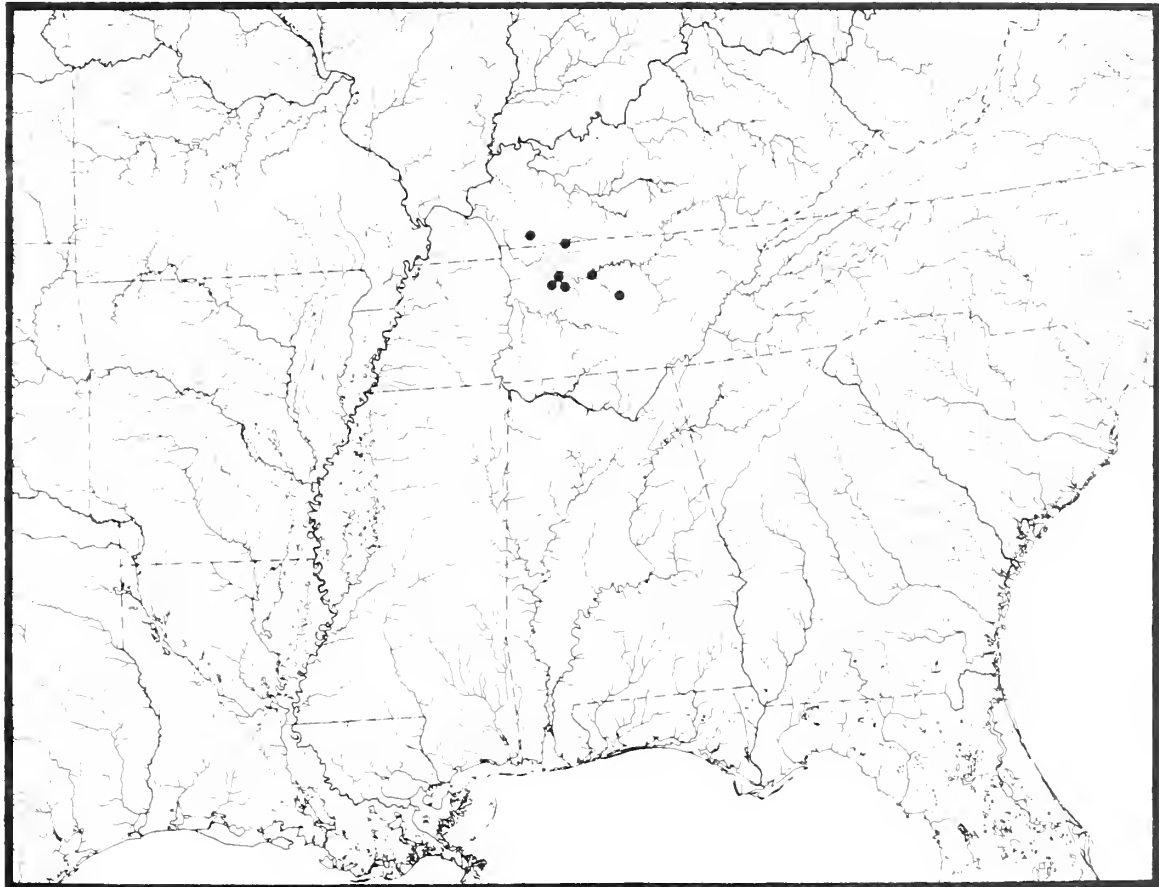
Order Perciformes
Family Percidae

TYPE LOCALITY: East Fork Stones River, hwy. 231, 9.6 km n of Murfreesboro, Rutherford Co., TN (Raney and Zorach 1967. Am. Midl. Nat. 77:93-103).

SYSTEMATICS: Subgenus *Nothonotus*. Appears to be most closely related to *E. moorei* (Raney and Zorach 1967).



TN: Cheatham Co., Turnbull Creek, 56 mm SL (R. T. Bryant, Jr.).



DISTRIBUTION AND HABITAT: Lower Cumberland drainage; over fine gravel and rubble in riffles and runs. Rare to common at specific localities.

BIOLOGY: Little known. Coloration and species associates noted by Raney and Zorach (1967).

ADULT SIZE: 35-60 mm SL.

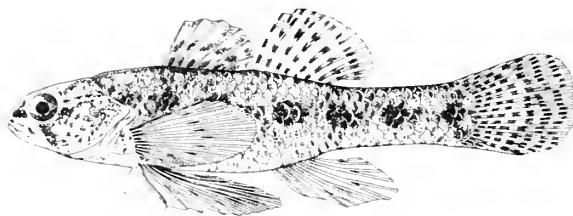
Compiler: J. R. Stauffer, Jr. September 1978.

Etheostoma microperca
Jordan and Gilbert
Least darter

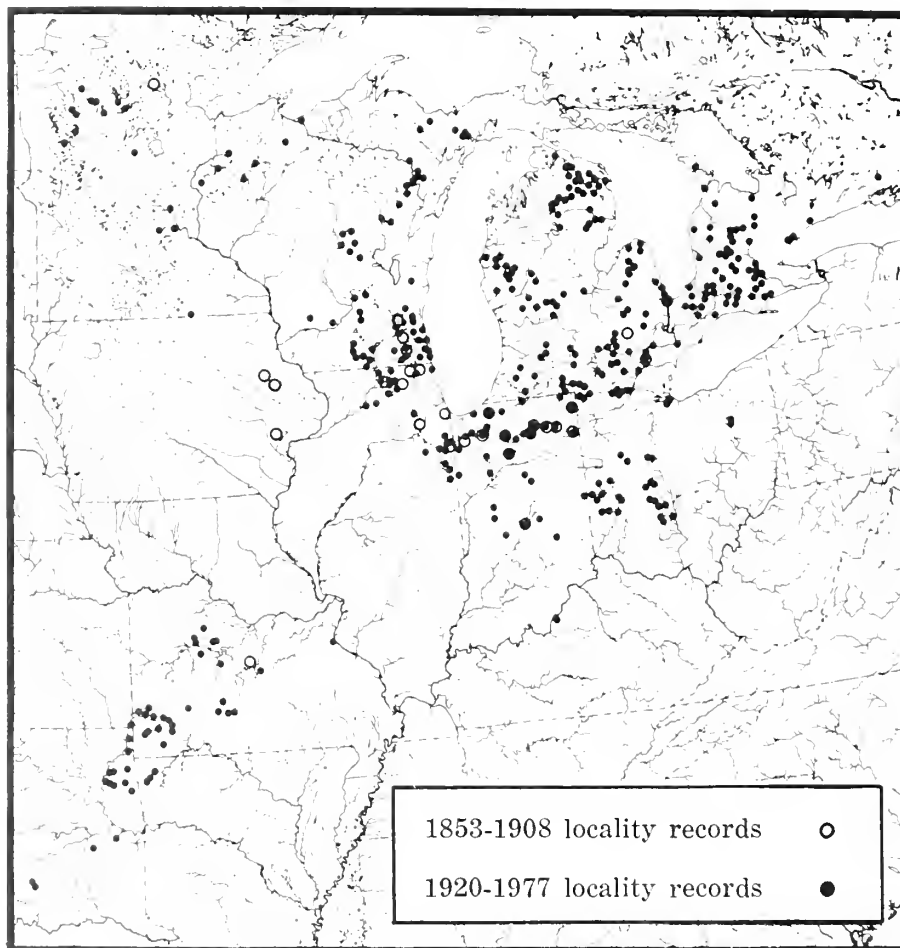
Order Perciformes
Family Percidae

TYPE LOCALITY: Oconomowac River at Lac la Belle, Waukesha Co., WI (Jordan and Gilbert in Gilbert 1887. Proc. U.S. Natl. Mus. 10:47-64), subsequently designated by Burr (1978. Bull. Ala. Mus. Nat. Hist. 4:1-53).

SYSTEMATICS: Subgenus *Microperca*, with *E. fonticola* and *E. proeliare*. Burr (1978) revised systematics of group. *Microperca* is highly specialized and most closely related to subgenus *Hololepis*.



IL: Iroquois Co., trib., Iroquois River, male, 30 mm SL (Burr 1978).



Map modified from Burr 1978

DISTRIBUTION AND HABITAT: Moira River, ON, west throughout Great Lakes to Red River of North system MN. Disjunct populations in Ozark Upland region, and further isolated populations in Blue River, OK. Extirpated in IA. May be common in clear, quiet, heavily vegetated waters such as pools of medium to small-sized creeks with permanent flow, pothole lakes, spring pools and seeps.

ADULT SIZE: 25-37 mm SL.

BIOLOGY: Petravicz (1936. Copeia:77-82) and Winn (1958a. Ecol. Monogr. 28:155-91;

1958b. Am. Midl. Nat. 59:190-212) reported reproductive behavior and general ecology. Forbes (1880. Bull. Ill. State Lab. Nat. Hist. 1:18-65) analyzed food habits. Bangham and Hunter (1939. Zoologica 24:385-448) and Lincicome and Van Cleave (1949. Am. Midl. Nat. 41:421-31) analyzed parasites. Burr and Page (1979. Ill. Nat. Hist. Surv. Biol. Notes 112:1-15) studies life history in Iroquois River, IL. Most complete general summary by Scott and Crossman (1973. *Freshwater Fishes of Canada*).
Compiler: B. M. Burr. September 1979.

***Etheostoma moorei* Raney and
Suttkus**
Yellowcheek darter

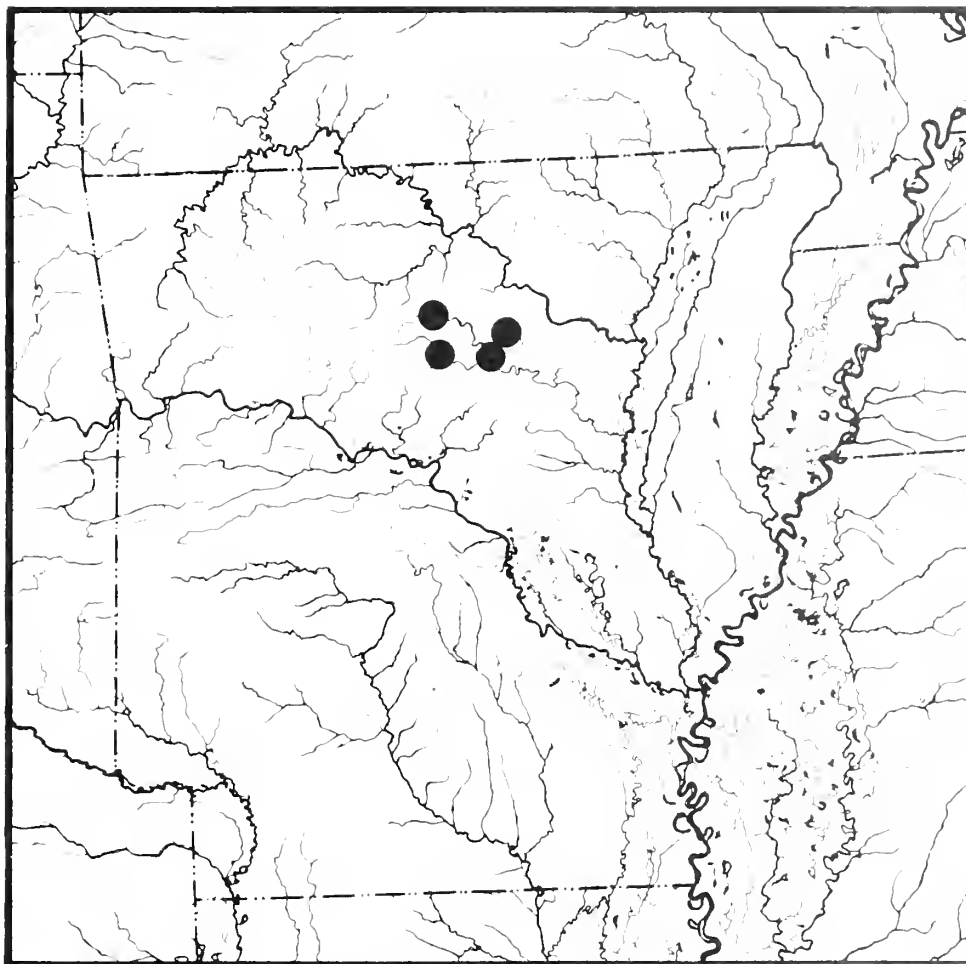
Order Perciformes
Family Percidae

TYPE LOCALITY: Devil's Fork of Little Red River, 4.0 km sw of Woodrow and 9.7 km w of Drasco, Cleburne Co., AR (Raney and Suttkus 1964. Copeia:130-39).

SYSTEMATICS: Subgenus *Nothonotus*. Most closely related to allopatric *E. rubrum* (Zorach 1972. Copeia:427-47).



AR: Van Buren Co., Little Red River, 51 mm SL (NCSM).



Map modified from Buchanan 1973.
Key to the Fishes of Arkansas

DISTRIBUTION AND HABITAT: Confined to upper clear swift sections of Little Red River system, White River drainage, AR. Only *Nothonotus* west of Mississippi River. Prefers faster sections of riffles with gravel, rubble, and boulder bottoms.

BIOLOGY: Sexual dimorphism pronounced, with males taking on bright color in late fall through April (Raney and Suttkus 1964). No life history information published. Robison (1974. Arkansas Acad. Sci. Proc. 28:62) and Buchanan (1974. in *Arkansas Natural Area Plan*) consider this species to be rare and endangered.

ADULT SIZE: 39-60 mm SL.

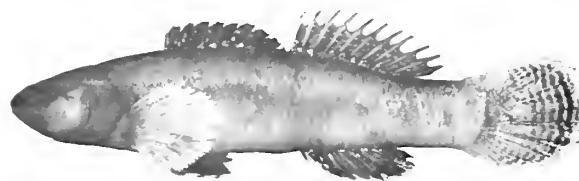
Compiler: H. W. Robison. May 1978.

Etheostoma neopterum Howell and
Dingerkus
Lollypop darter

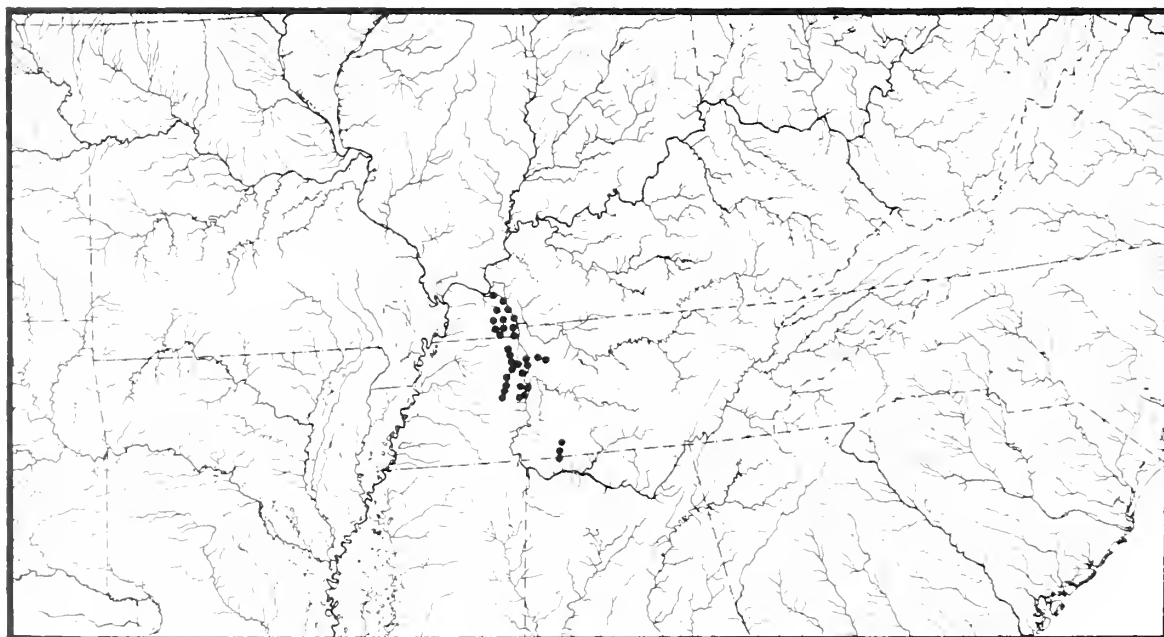
Order Perciformes
Family Percidae

TYPE LOCALITY: Little Butler Creek, 0.6 km e state route 13 and 0.8 km n AL state line, Wayne Co., TN (Howell and Dingerkus 1978. Bull. Ala. Mus. Nat. Hist. 3:13-26).

SYSTEMATICS: Subgenus *Catonotus*. Closest relatives *E. squamiceps* (Howell and Dingerkus 1978) and *E. olivaceum* (Braasch and Page 1979. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 78:1-10).



TN: Benton Co., Beaverdam Creek, breeding male, 48 mm SL (INHS).



DISTRIBUTION AND HABITAT: Common in tributaries of lower Tennessee River from Decatur Co., TN, to mouth of Tennessee River, and in Shoal Creek system in southcentral TN, and northwestern AL. Occupies slab-rock pools and bank undercuts of small streams.

ADULT SIZE: 35-62 mm SL.

BIOLOGY: Spawns in April on undersides of slab rocks (Page and Mayden 1979. Trans. Ky. Acad. Sci. 40:56-57). Preyed upon by *Cottus caroliniae* and *Necturus maculosus* (Howell and Dingerkus 1978).

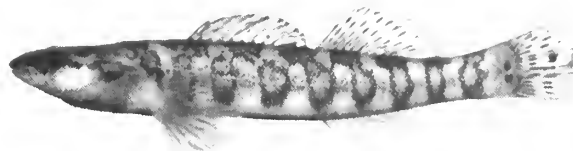
Compiler: L. M. Page, Sept. 1979.

Etheostoma nianguae Gilbert
and Meek
Niangua darter

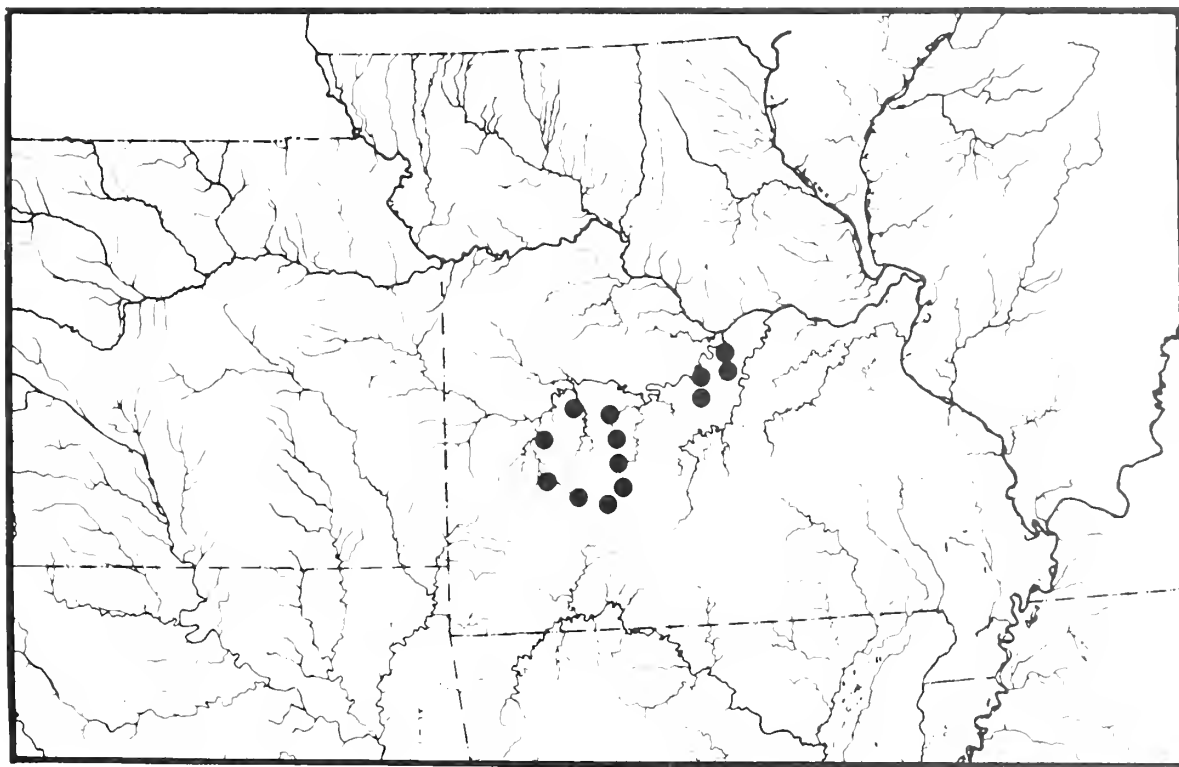
Order Perciformes
Family Percidae

TYPE LOCALITY: Headwaters of Niangua River near Marshfield, Webster Co., MO (Gilbert and Meek in Gilbert 1888. Proc. U. S. Natl. Mus. 10:47-64).

SYSTEMATICS: Subgenus *Oligocephalus* (Bailey and Gosline 1955. Misc. Publ. Mus. Zool. Univ. Mich. 93:1-44). Most closely related to *E. sagitta* (Kuehne and Bailey 1961. Copeia:1-8).



MO: Osage Co., Maries River,
66 mm SL male (Mo. Dept.
Cons.)



Map modified from Pflieger 1975

DISTRIBUTION AND HABITAT: Rare and localized in north-flowing tributaries of the Osage River, MO, from Sac River east. Restricted to clear upland streams of medium size, avoiding headwater creeks and large Ozark rivers. Found most of year in shallow pools and runs having slight currents and gravel or rock substrates.

BIOLOGY: Diet is comprised mostly of stonefly and mayfly nymphs gleaned from interstices of stream bottom. Individuals seldom live more than two years. Spawning occurs in April on swift riffles. Female buries herself in gravel substrate during spawning.

ADULT SIZE: 58-88 mm SL.

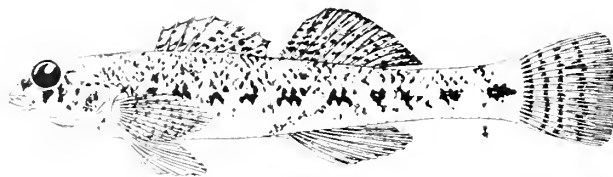
Compiler: W. L. Pflieger. April 1978.

***Etheostoma nigrum* Rafinesque**
Johnny darter

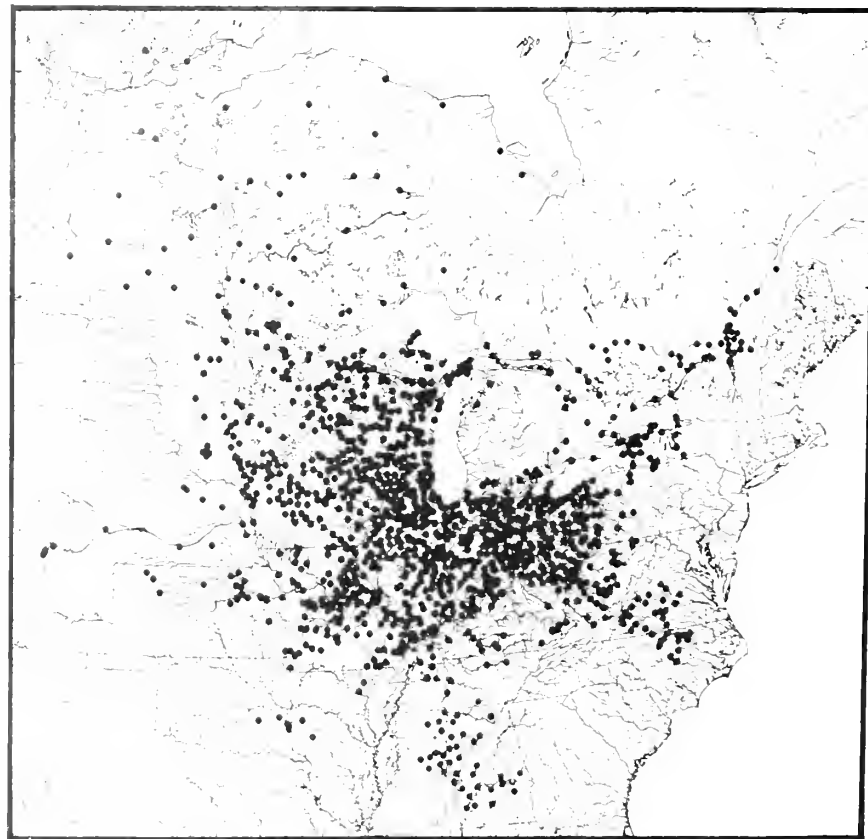
Order Perciformes
Family Percidae

TYPE LOCALITY: Green River, KY (Rafinesque 1820. *Ichthyologia Ohiensis*).

SYSTEMATICS: Subgenus *Boleosoma*. Cole (1965. *Copeia*:8-13) and McAllister et al. (1972. *J. Fish. Res. Board Can.* 29:1173-80) provided evidence for distinction of *E. nigrum* from *E. olmstedii* as a species, but with some hybridization. Cole (1967. *Chesapeake Sci.* 8:28-51) recognized three subspecies: *E. n. culepis*, *E. n. nigrum*, and *E. n. susanae*. Underhill (1963. *Am. Midl. Nat.* 70:470-78) and Collette and Knapp (1967. *Proc. U.S. Natl. Mus.* 119:1-88) did not recognize *E. n. culepis*. Cole (in Holt [ed.] 1972. *Va. Polytech. Inst. State Univ. Res. Div. Monog.* 4:119-38) reported racial distinctiveness of populations in James, Roanoke, Tar, and Neuse drainages.



MD: Garrett Co., Casselman River (NCSM).



DISTRIBUTION AND HABITAT: *E. n. nigrum* ranges from Hudson and James Bay drainages in Canada south to AR, as far west as CO and east to NC. *E. n. culepis* is found in areas once covered by Wisconsin glaciation, in discontinuous populations surrounded by areas of intergradation which then grade into areas of *E. n. nigrum*. *E. n. susanae* is confined to a few tributaries of upper Cumberland drainage, KY.

ADULT SIZE: 20-58 mm SL.

BIOLOGY: Roberts and Winn (1962. *Copeia*: 567-70) discussed feeding behavior. Winn (1958a. *Ecol. Monogr.* 28:155-91; 1958b. *Am. Midl. Nat.* 59:190-212) studied spawning behavior. Speare (1960. *Copeia*:241-43) studied age and growth in Augusta Creek, MI. Hoffman (1967. *Parasites of North American Freshwater Fishes*) listed parasites.

Compiler: J. C. Bruner. March 1978.

Etheostoma nuchale Howell
and Caldwell
Watercress darter

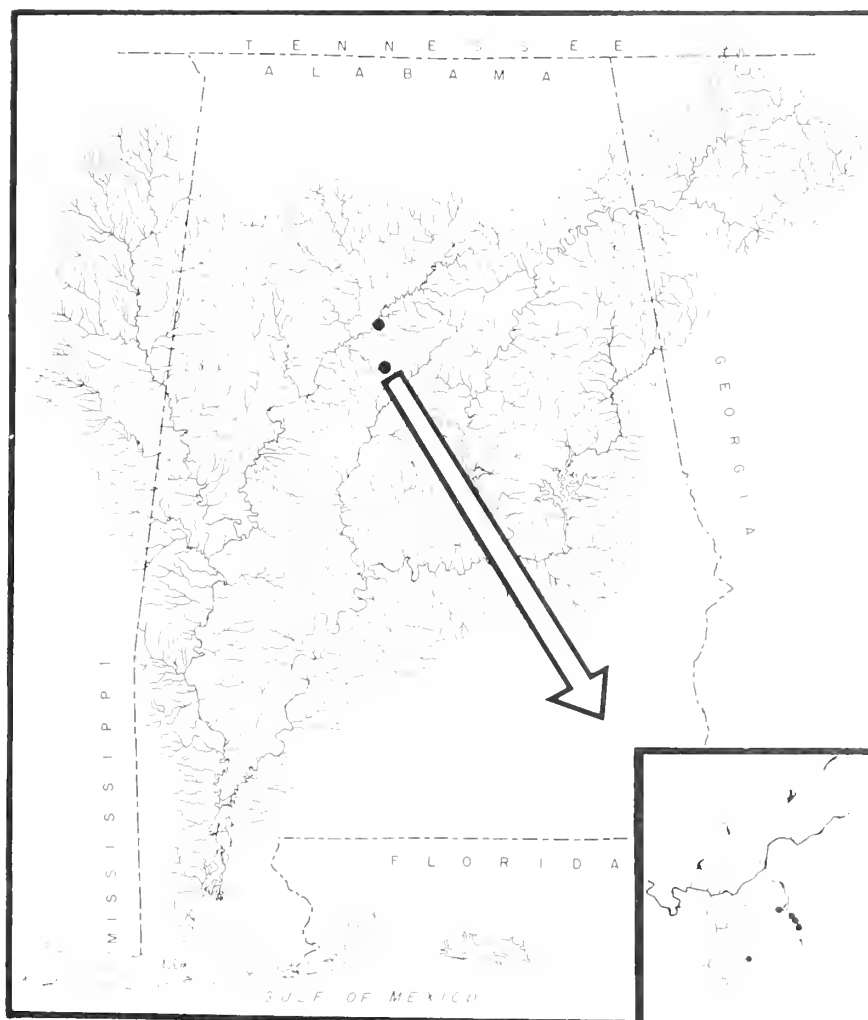
Order Perciformes
Family Percidae

TYPE LOCALITY: Glenn Spring, tributary to Halls Creek, Black Warrior River system, along hwy. 20, at Bessemer, Jefferson Co., AL (Howell and Caldwell 1965. Tulane Stud. Zool. 12:101-08).

SYSTEMATICS: Subgenus *Oligocephalus*.
Derivative of *E. swaini*.



AL: Jefferson Co., Glenn
Spring at Bessemer, 25 mm
SL (NCSM).



DISTRIBUTION AND HABITAT: Formerly thought restricted to type locality. Now known from three other localities on Halls Creek, and from Roebuck Springs, tributary to Village Creek. Found in watercress-choked waters of limestone origin. Substrate consists of angular gravel in riffle areas, and silt and mud in areas of watercress. Abundant only in Roebuck Springs. Numbers have declined markedly at the type locality because of lowered water levels.

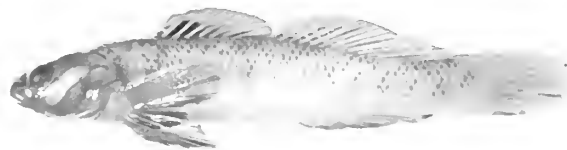
ADULT SIZE: 26-45 mm SL.

BIOLOGY: Only among watercress and known to perch upon leaves and roots at mid-water depth. Does not normally live on the bottom as do most darters. Feeds on snails, crustaceans, and insect larvae. Gravid females collected from March to July. Life history study currently underway at Sanford University.

Compiler: S. P. Platania. March 1978.

Etheostoma obeyense Kirsch
Barcheek darter

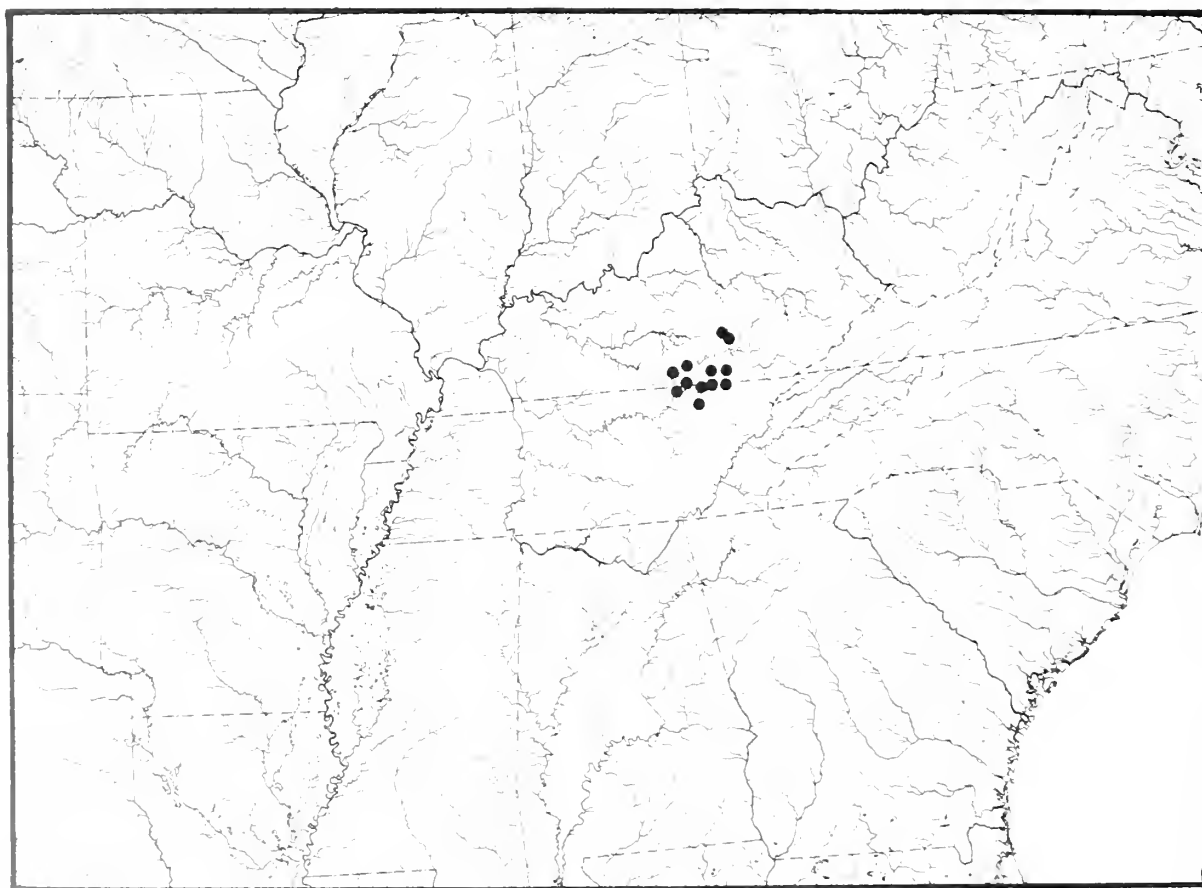
Order Perciformes
Family Percidae



TYPE LOCALITY: Tributaries of Cumberland River, Clinton Co., KY (Kirsch 1892. Bull. U. S. Fish. Comm. [1890] 10:289-92).

SYSTEMATICS: Subgenus *Catonotus*. Closest relatives are other barcheek darters: *E. barbouri*, *E. smithi*, *E. striatulum*, and *E. virgatum* (Page 1975. Copeia:782-84; Page and Braasch 1976. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 60:1-18). Geographic variation discussed by Page and Braasch (1976).

KY: Pulaski Co., Pitman Creek, male, 60 mm SL (INHS).



Map modified from Page and Braasch 1976

DISTRIBUTION AND HABITAT: Common in tributaries of middle Cumberland River from Obey River east to Big South Fork, TN and KY. Occupies slab-rock and bedrock pools of small to large streams.

BIOLOGY: Page and Schemske (1978. Copeia:406-12) examined competition with other *Catonotus*.

ADULT SIZE: 30-70 mm SL.

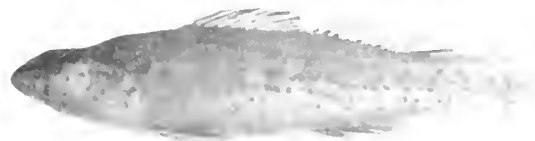
Compiler: L. M. Page. December 1978.

Etheostoma okaloosae (Fowler)
Okaloosa darter

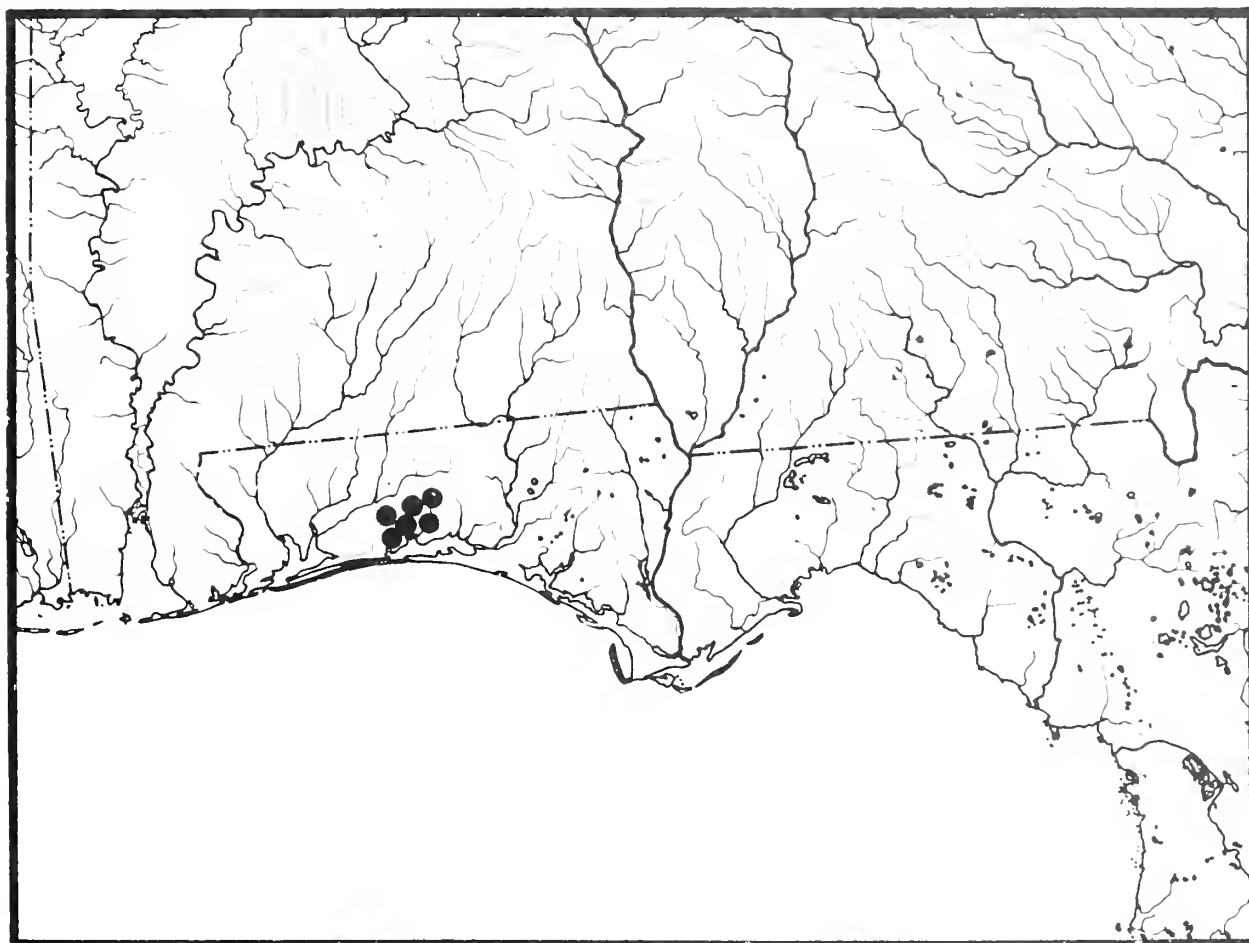
Order Perciformes
Family Percidae

TYPE LOCALITY: Little Rocky Creek, 11.3 km ne of Niceville on route 218, Okaloosa Co., FL (Fowler 1941. Proc. Acad. Nat. Sci. Phila. [1940] 92:227-44).

SYSTEMATICS: Subgenus *Villora*. Closest relative (only other member of subgenus) is *E. edwini*. Species recognized as valid by Yerger (1960. ASB Bull. 7:41), redescribed by Collette and Yerger (1962. Tulane Stud. Zool. 9:213-30).



FL: Okaloosa Co., Long Creek,
49 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Limited to six small streams draining into Rocky and Boggy bayous of Choctawhatchee Bay drainage near Valparaiso, FL. Total range encompasses about 100,000 acres. Occupies small to moderate streams at depths ranging from 1-2 cm to 2 m; usually associated with aquatic vegetation (Collette and Yerger 1962; Mettee et al. 1976. Proc. Southeast. Fishes Council. 1:1-3). Often fairly common. Estimates of total number of individuals throughout entire range vary from 1,500 to 10,000.

ADULT SIZE: 35-50 mm SL.

BIOLOGY: Guillory (Fla. Game and Freshwater Fish Comm.) is beginning a study of life history and ecology for species. Yerger (*in* Gilbert 1978. Rare and Endangered Biota of Florida. Vol. 4:2-4) presented best summary of known information.

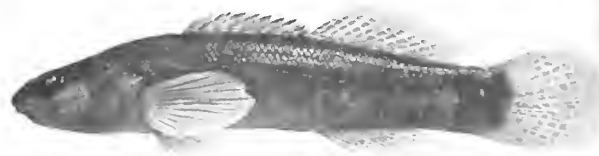
Compiler: J. R. Stauffer, Jr. March 1978.

Etheostoma olivaceum Braasch and
Page
Dirty darter

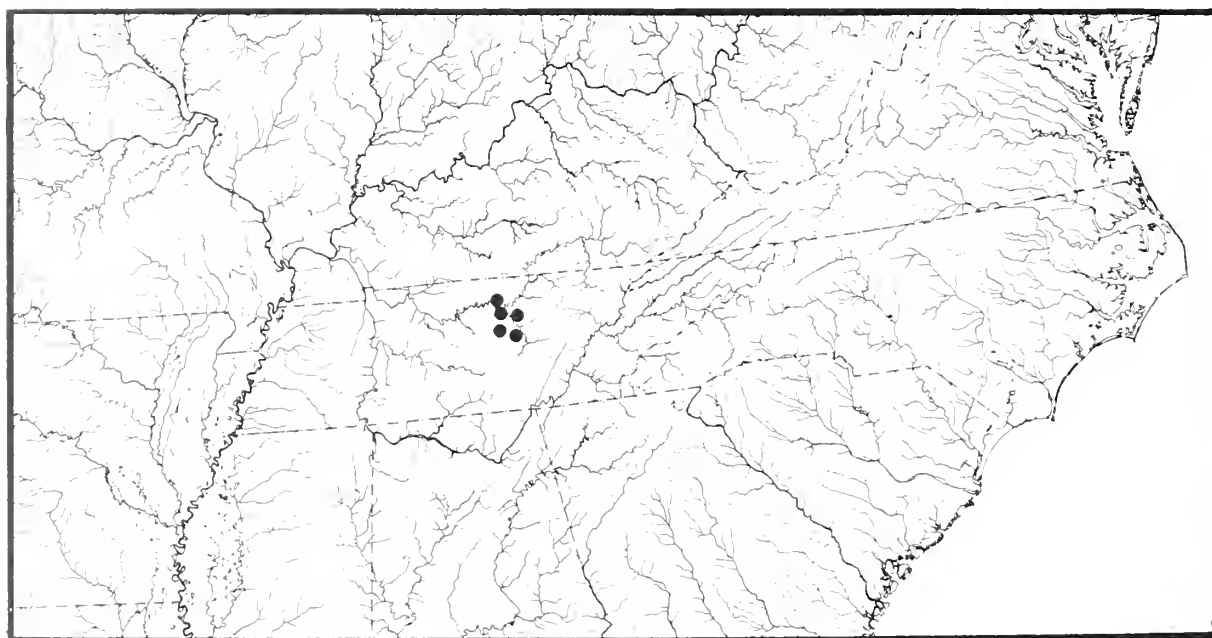
Order Perciformes
Family Percidae

TYPE LOCALITY: Rock Springs Branch at Rock Springs Church, 2 km n Buffalo Valley, Putnam Co., TN (Braasch and Page 1979. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 78:1-10).

SYSTEMATICS: Subgenus *Catonotus*. Closest relatives *E. squamiceps* and *E. neopterum* (Braasch and Page 1979).



TN: Putnam Co., Rock Springs Branch, male, 51 mm SL (INHS).



Map modified from Braasch and Page 1979

DISTRIBUTION AND HABITAT: Restricted to tributaries of lower Caney Fork and nearby small tributaries of Cumberland River in central TN. Abundant in tributaries of Caney Fork; sporadic and uncommon in tributaries of Cumberland River. Occupies pools and riffles of small, rock-bottom streams.

ADULT SIZE: 35-65 mm SL.

BIOLOGY: Page (in press. Ill. Nat. Hist. Surv. Biol. Notes) discusses life history in Brush Creek, TN. Spawns March to May on undersides of slab rocks. Lives to maximum of 27 months. Diet mostly immature insects and small crustaceans.

Compiler: L. M. Page, Sept. 1979.

***Etheostoma olmstedii* Storer**
Tessellated darter

Order Perciformes
Family Percidae

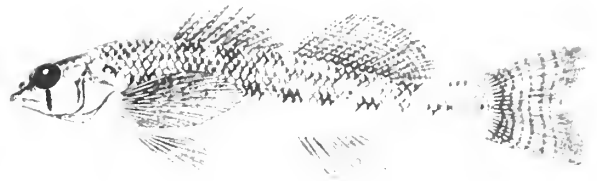
TYPE LOCALITY: Connecticut River at Hartford, CT (Storer 1842. Boston J. Nat. Hist. [1843-44] 4:58-62).

SYSTEMATICS: Subgenus *Boleosoma*. Previously considered subspecies of *E. nigrum*, but Cole (1965. Copeia:8-13) recognized as distinct species. McAllister et al. (1972. J. Fish. Res. Board Can. 29:1173-80), using principal component analysis of morphological and electrophoretic characters in ON specimens, continued this usage but noted some hybridization with no evidence of backcrossing. Cole (1967. Chesapeake Sci. 8:28-51) recognized four subspecies. Zorach (1971. Chesapeake Sci. 11:254-63) discussed systematics of *E. o. olmstedii* and *E. o. atromaculatus*.

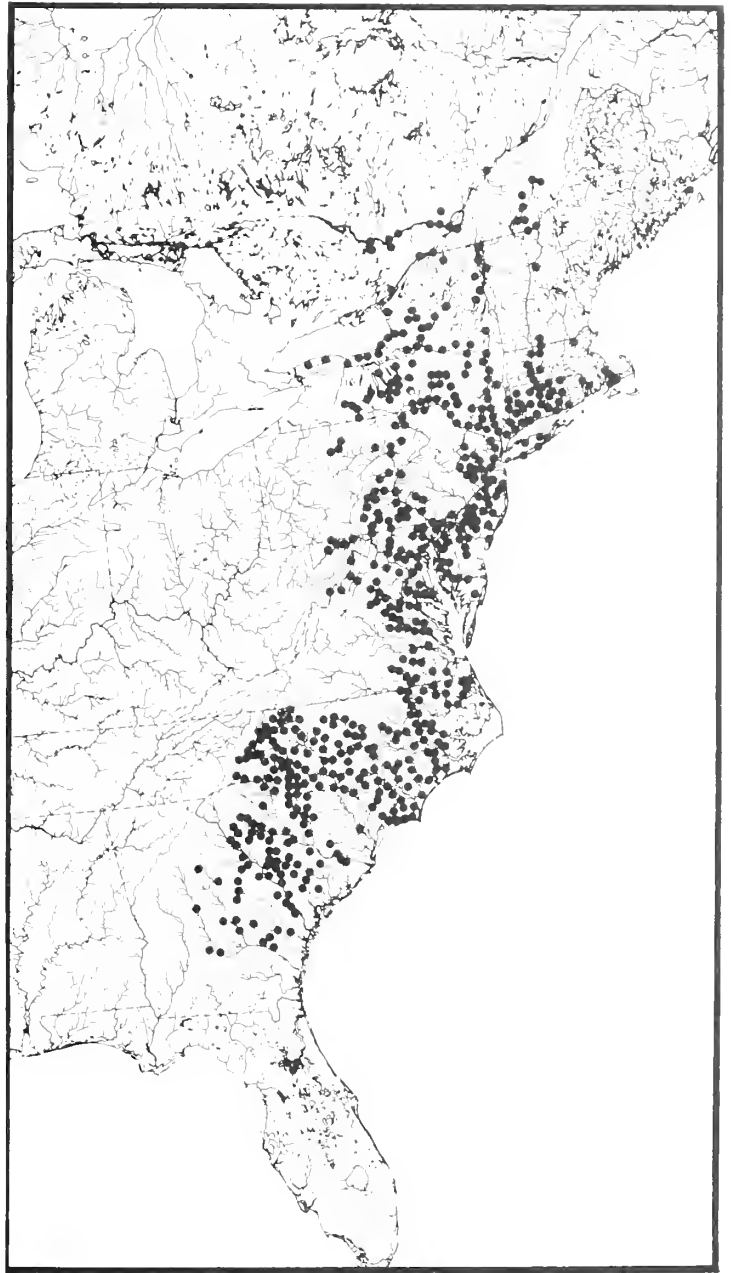
DISTRIBUTION AND HABITAT: Confined to Atlantic slope drainages from Ste. Foy, Quebec City, QU, south to Altamaha River, GA, with disjunct population in lower Oklawaha River, FL. Cole (1957. Ph.D. diss., Cornell Univ.) mapped distribution of subspecies and provided information on post-Pleistocene distribution. South of Susquehanna River known only from below Fall Line, except in Potomac, Rappahannock, York, Roanoke, upper Cooper and Pee Dee drainages. Common in pools of streams and larger, low gradient rivers; favors shallow area with sand, mud, or rubble bottom. Avoids strong riffles. Occasionally found in brackish (to 13 ppt) waters.

ADULT SIZE: 44-62 mm TL, 81 mm TL maximum.

BIOLOGY: Hardy (1978. *Development of fishes of Mid-Atlantic Bight* Vol. 3.) depicted eggs and larvae and summarized known information. Matures at 40 mm, spawns in moderate current in water from less than 30 cm to 61 cm deep over marl, sand, gravel, or stone, usually under rocks. Males excavate nests, generally under stones, and guard eggs. Spawn May (perhaps April) to June in MD. April to May (June) in NY. Demersal eggs (54-688) about 1.5 mm diameter are laid in single layer 2-8 cm wide. Hatch at length 5.1 mm or smaller. Juveniles about 37 mm SL, typically live to three, sometimes four years of age (Raney and Lachner 1943. Am. Midl. Nat. 29:229-38). Tsai (1972. Trans. Am. Fish Soc. 101:80-88) discussed life history with respect to dams and pollution.



MD: Baltimore Co., George's Run (NCSM).



Compilers: D. S. Lee and D. E. McAllister.
October 1978.

Etheostoma osburni (Hubbs and
Trautman)
Finescale saddled darter

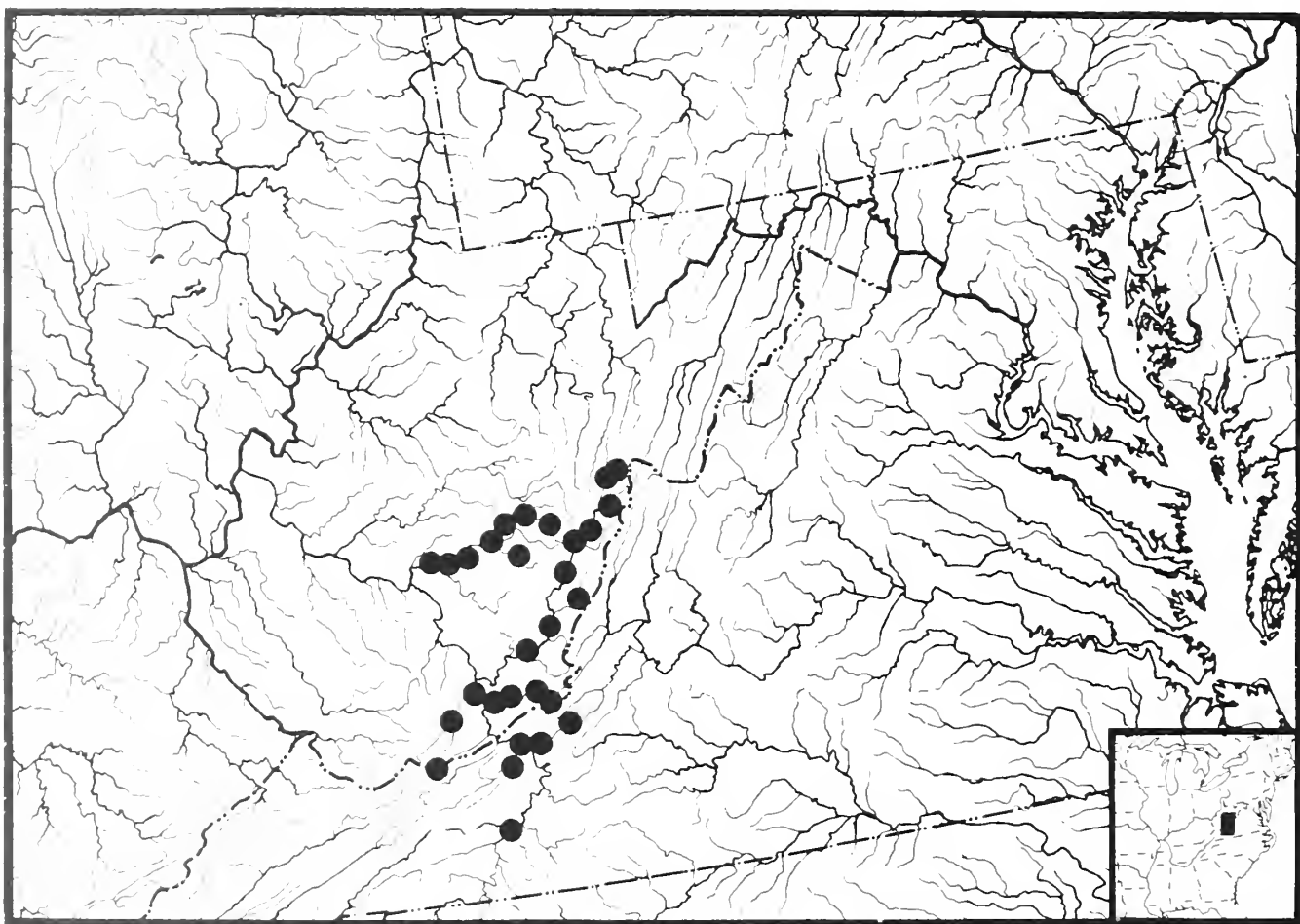
Order Perciformes
Family Percidae

TYPE LOCALITY: Stony Creek, tributary to Greenbrier River, Pocahontas Co., WV (Hubbs and Trautman 1932. Ohio J. Sci. 32:31-38).

SYSTEMATICS: Subgenus *Etheostoma*. Member of *E. variatum* group; most closely related to *E. kanawhae*. Hubbs and Black (1940. Occas. Pap. Mus. Zool. Univ. Mich. 416:1-30) reviewed complex prior to description of *E. kanawhae*.



VA: Wythe Co., Reed Creek,
52 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Widely distributed, locally common endemic of lower New (upper Kanawha) River drainage. Presence below Kanawha Falls, WV, in Elk River system (*vide* Schwartz *in* Jenkins et al. 1972. Va. Polytech. Inst. State Univ. Res. Div. Monogr. 4:43-117) in doubt. No records in New River system upstream from Reed Creek, where replaced by *E. kanawhae*. Occupies rocky riffles. Appears to be most common in cool to cold sections of moderate to small streams.

ADULT SIZE: 60-85 mm TL.

BIOLOGY: Spawning of Greenbrier River, WV, populations typically peaks mid-to-late May.

Compilers: C. H. Hocutt, R. E. Jenkins, and J. R. Stauffer, Jr. October 1978.

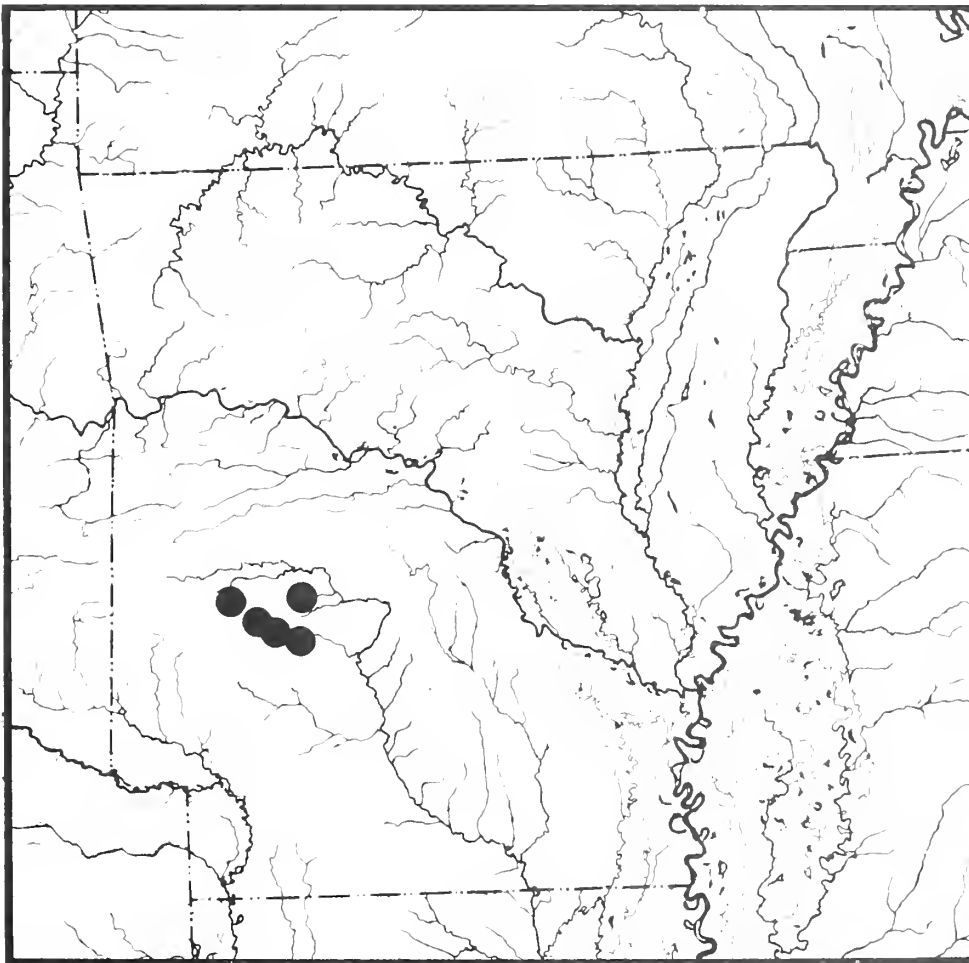
Etheostoma pallididorsum Distler
and Metcalf
Paleback darter

Order Perciformes
Family Percidae

TYPE LOCALITY: Caddo River, 13.7 km w of Black Springs, T3S, R27W, Sec. 26, Montgomery Co., AR (Distler and Metcalf 1962. Copeia: 556-61).

SYSTEMATICS: Subgenus *Oligocephalus*. In *E. punctulatum* species group (Wall and Williams 1974. Tulane Stud. Zool. Bot. 18:172-82). Allopatric relative of *E. cragini* in Arkansas River drainage (Distler and Metcalf 1962.; Blair 1964. Southwest. Nat. 9:105-07) and closely related to *E. boschungii* (Wall and Williams 1974).

AR: Montgomery Co., Caddo River, 41 mm SL (NCSM).



Map modified from Buchanan 1973

DISTRIBUTION AND HABITAT: Inhabits upper portions of Caddo River with a disjunct population in upper Ouachita River tributary (Robison 1974. Am. Midl. Nat. 91:478-79). Preferred habitat seems to be quiet, shallow pools at margins of gravel bottomed, spring-fed streams and rivulets. Occasionally found associated with vegetation over mud substrates. Generally avoids swift-riffle sections.

ADULT SIZE: 31-47 mm SL.

BIOLOGY: Virtually nothing has been published on life history of *E. pallididorsum*. Preliminary unpublished data collected by H. W. Robison and P. S. Hambrick suggest that this species feeds on cladocerans, ephemeropterans, and dipteran larvae. Maximum spawning activity probably occurs in February and March and ceases by early summer.

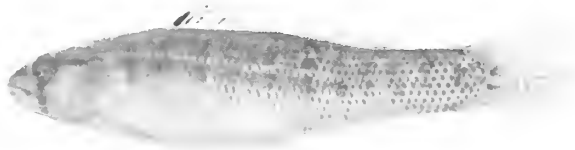
Compiler: H. W. Robison. May 1978.

Etheostoma parvipinne Gilbert and Swain
Goldstripe darter

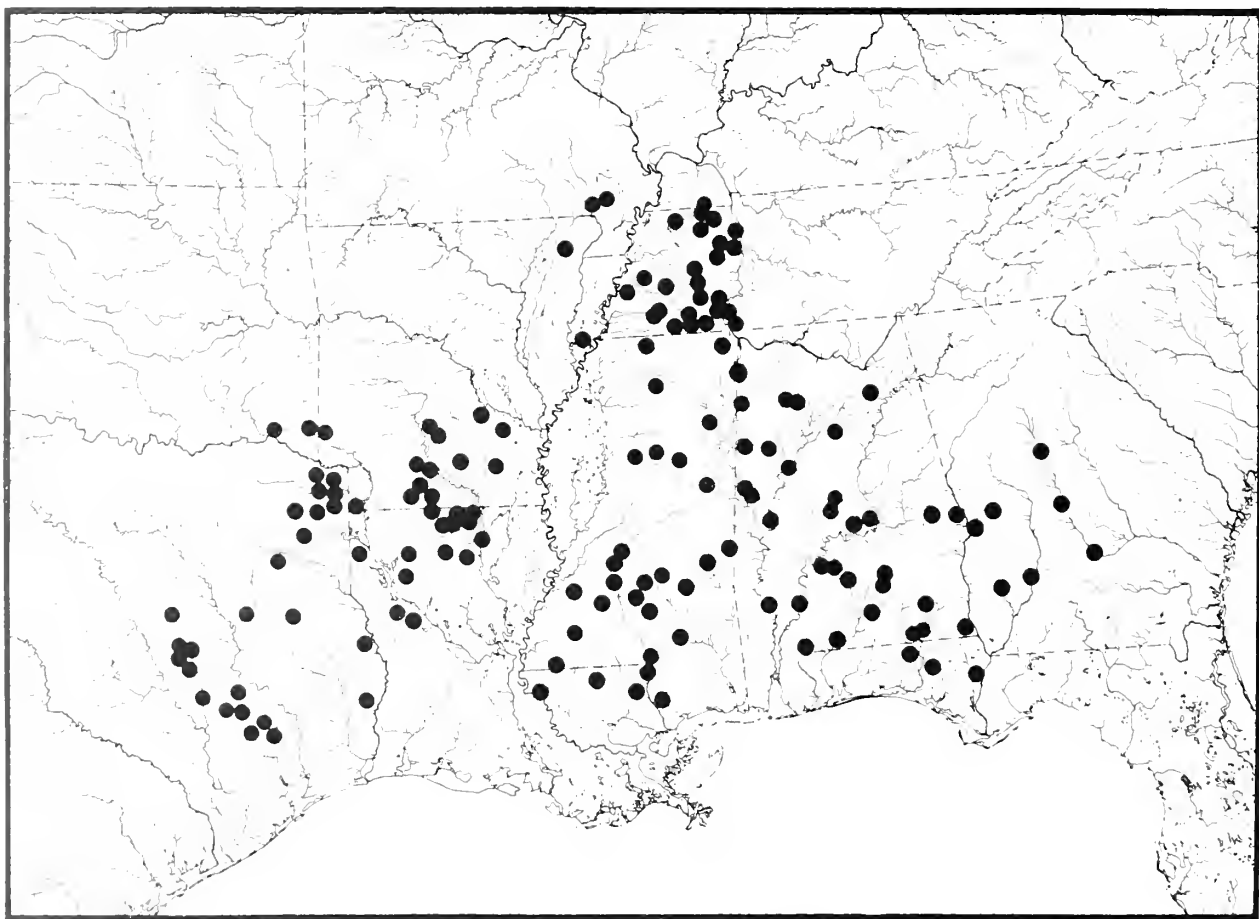
Order Perciformes
Family Percidae

TYPE LOCALITY: Small spring-branch, tributary to the Black Warrior River at Tuscaloosa, AL (Gilbert and Swain in Gilbert 1887. Proc. U. S. Natl. Mus. 10:47-64).

SYSTEMATICS: Subgenus *Oligocephalus*. Forms a natural species group with *E. fricksium* and *E. mariae*. Apparently derived from an *E. fricksium* prototype and shows advancements such as loss or reduction in first dorsal fin color and presence of incomplete supratemporal canal (Richards 1963. Ph.D. diss., Cornell Univ.).



AL: Autauga Co., Alabama
River System, 47 mm SL
(Smith-Vaniz 1968).



Map modified from Richards 1963

DISTRIBUTION AND HABITAT: Coastal Plain species that ranges from St. Francis River in AR and MO, southwest in OK and TX, east in Mississippi River tributaries in western TN and east along Gulf slope to Altamaha River drainage GA. Has not been collected above Fall Line. Prefers small springs and feeder streams of low to moderate gradient. Taken over sand in areas of detrital buildup and over gravel riffles. Occasionally associated with vegetation. Seems

to be less common and more spotty in distribution in eastern part of range.

ADULT SIZE: 36-56 mm SL.

BIOLOGY: Nothing published.

Compiler: F. C. Rohde. July 1978.

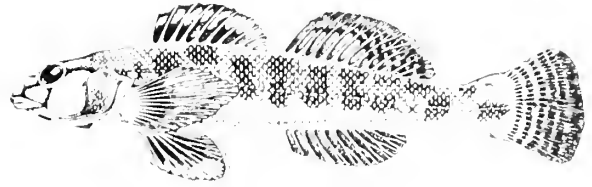
Etheostoma perlongum (Hubbs and Raney)

Waccamaw darter

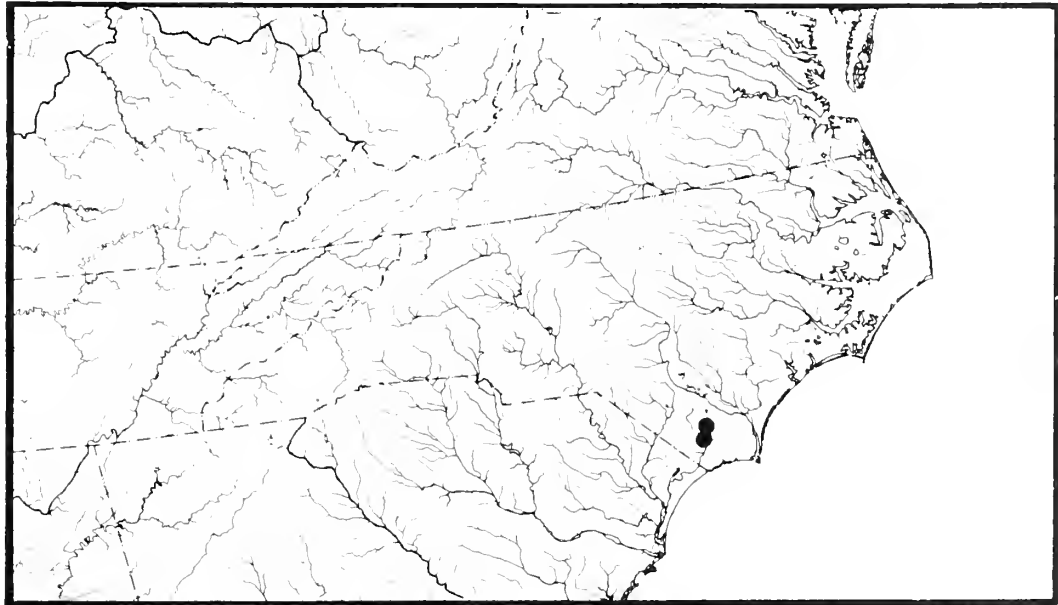
Order Perciformes
Family Percidae

TYPE LOCALITY: North shore of Lake Waccamaw, Columbus Co., NC (Hubbs and Raney 1946. Misc. Publ. Mus. Zool. Univ. Mich. 65:1-30).

SYSTEMATICS: Subgenus *Boleosoma*. Lacustrine derivative of *E. olmstedii* (Hubbs and Raney 1946) or an earlier *Boleosoma* stock (Cole in Holt 1972 [ed.]. Va. Polytech. Inst. State Univ. Res. Div. Monogr. 4: 119-38).



NC: Columbus Co., Lake Waccamaw, 68 mm SL (UNC-W).



DISTRIBUTION AND HABITAT: Endemic to Lake Waccamaw, a shallow Coastal Plain lake in southeastern NC. One specimen reported from roadside ditch near Old Dock, 12 km below lake (Bailey in Cooper et al. [eds.] 1977. *Endangered and Threatened Plants and Animals of North Carolina*: 265-98). Examination of many other specimens of Waccamaw River *Etheostoma*, however, revealed no additional *E. perlongum*.

ADULT SIZE: 44-75 mm SL.

BIOLOGY: Feeds mainly on chironomid larvae and amphipods. Adults migrate from mid-lake into shallow shoreline in early spring. Spawns March to June under submerged objects, usually sticks or logs, where male excavates shallow depression in sand. Egg-laying occurs upside down beneath object, and one female spawns 40-50 eggs. Each communal nest contains around 1200 eggs and is guarded by a male. Larvae benthic.

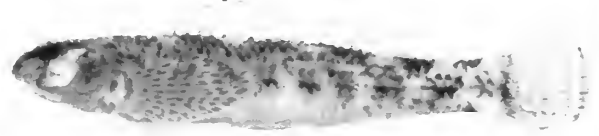
Compiler: P. W. Shute, June 1978.

Etheostoma podostemone Jordan and
Jenkins
Riverweed darter

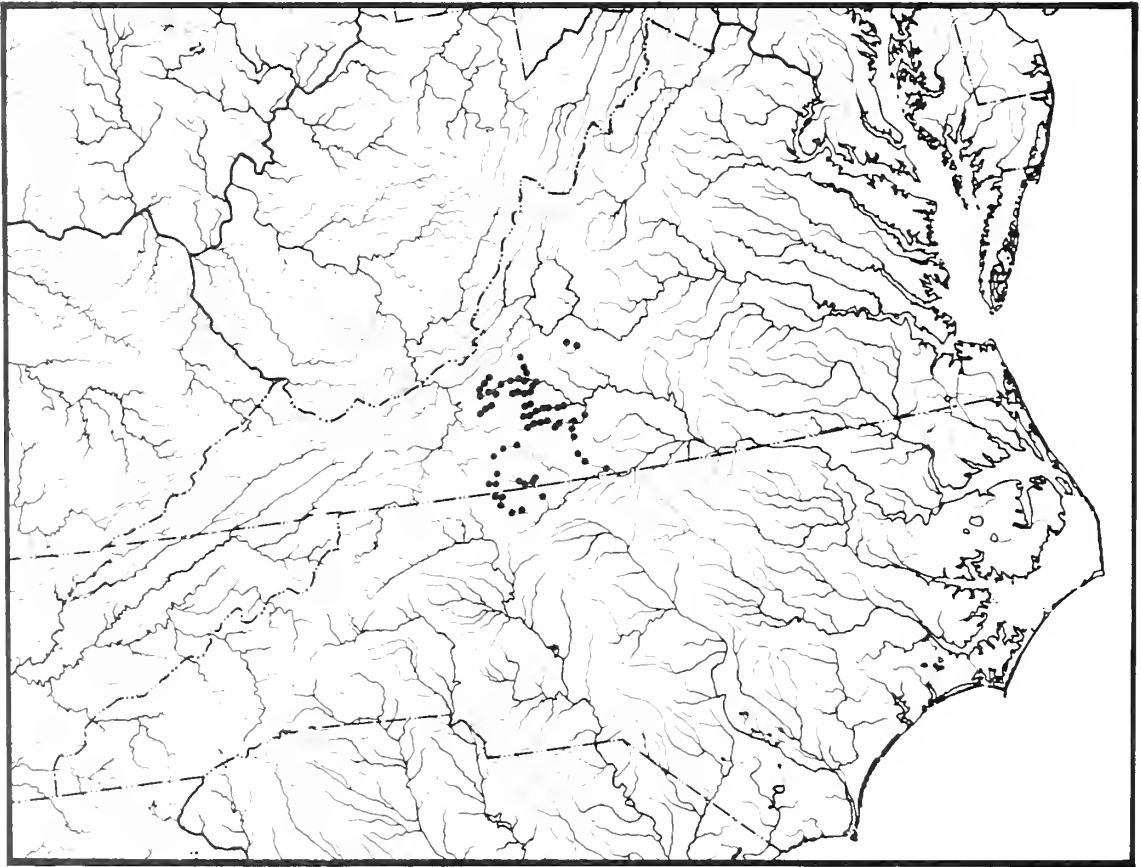
Order Perciformes
Family Percidae

TYPE LOCALITY: [South Fork of] Roanoke River at Alleghany Springs, Montgomery Co., VA (Jordan and Jenkins in Jordan 1889. Proc. U.S. Natl. Mus. [1888] 11:351-62). Lectotype designated by Cole (in Collette and Knapp 1967. Proc. U.S. Natl. Mus. 119:188).

SYSTEMATICS: Subgenus *Boleosoma*. Most closely related to, and well differentiated from, its geminate of adjacent James River drainage, *E. longimanum* (Miles 1964. M.S. thesis, Virginia Polytech. Inst. State Univ.; Cole in Holt [ed.] 1972. Va. Polytech. Inst. State Univ. Res. Div. Monogr. 4:119-38).



NC: Stokes Co., Dan River,
67 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to upper Roanoke River drainage, including Roanoke system proper and more southern Dan River system, VA and NC. Occurs widely in Ridge and Valley, Blue Ridge and upper Piedmont provinces, and, disjunctly, in middle Piedmont. Generally distributed in most of upper Roanoke proper, sporadic in upper and middle Dan. Occupies runs and riffles of gravel to boulder, in small to large, cool to warm, typically clear streams. Frequently associated with the vascular riverweed, *Podostemon*. Often common. Another member of *Boleosoma*, *E. nigrum*, inhabits slower currents in same streams.

ADULT SIZE: 35-70 mm SL.

BIOLOGY: Largely unknown. Probably similar to that of *E. longimanum*. Based on aquarium observations, spawns on underside of nest cover (Voiers, pers. comm.; 1964. Abstr. 45th Ann. ASIH). Apparently spawns April and May, based on nuptial color and gonadal development.

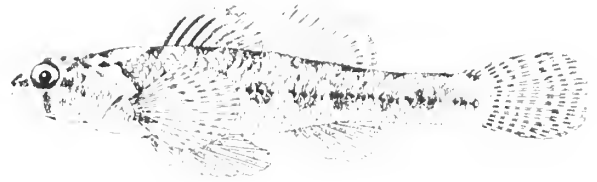
Compiler: R. E. Jenkins. January 1979.

Etheostoma proeliare (Hay)
Cypress darter

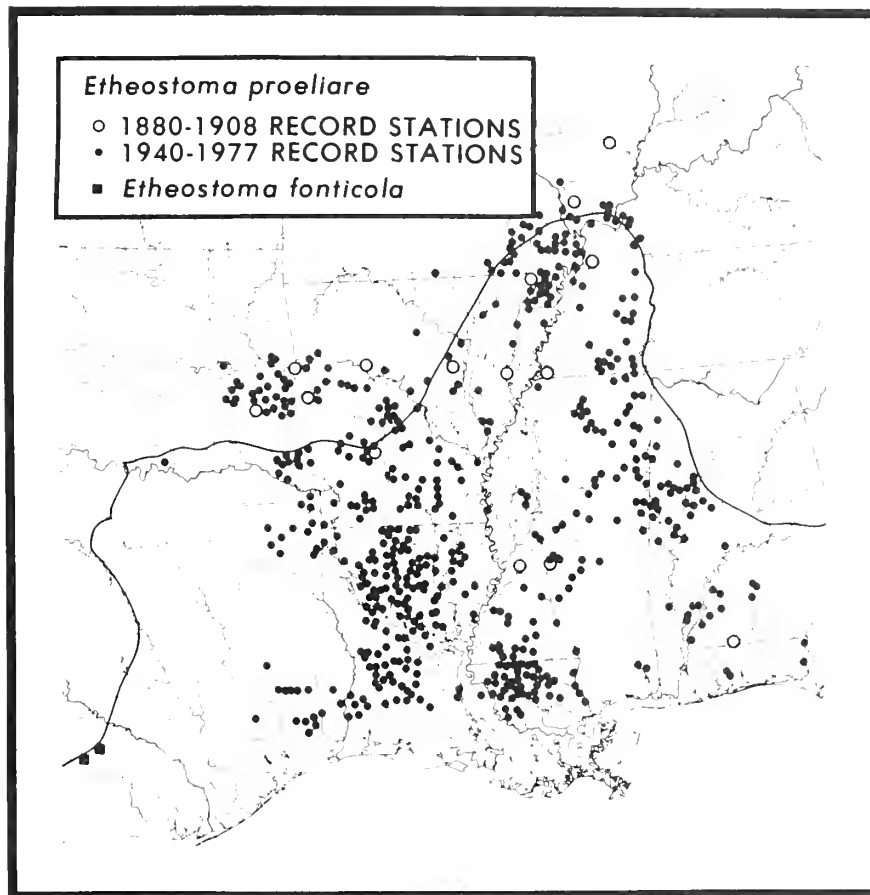
Order Perciformes
Family Percidae

TYPE LOCALITY: Tributary to Tuscombia River at Corinth, Alcorn Co., MS (Hay 1881. Proc. U.S. Natl. Mus. [1880] 3:488-515).

SYSTEMATICS: Subgenus *Microperca*. Most primitive member of subgenus. Closest relatives *E. fonticola* and *E. microperca*; of these two, *E. fonticola* is closest ally (Burr 1978. Bull. Ala. Mus. Nat. Hist. 4:1-53).



IL: Johnson Co., Max Creek, male, 33 mm SL (INHS).



DISTRIBUTION AND HABITAT: Western part of Gulf Coastal Plain, east to Choctawhatchee River, FL, southwest to San Jacinto River, TX, and north to Big Muddy River, IL. Especially common in lowland lakes, streams, bayous, swamps, and backwaters where bottom is soft and detritus and aquatic vegetation abound. Prefers quiet, often murky water.

ADULT SIZE: 29-39 mm SL.

BIOLOGY: Bangham and Venard (1942. J. Tenn. Acad. Sci. 17:22-38) analyzed parasites. Rice (1942. J. Tenn. Acad. Sci. 17: 4-13) reported on food habits. Definitive study and summary of previous literature by Burr and Page (1978. Ill. Nat. Hist. Surv. Biol. Notes 106:1-15).

Compiler: B. M. Burr, September 1978.

Etheostoma punctulatum (Agassiz)
Stippled darter

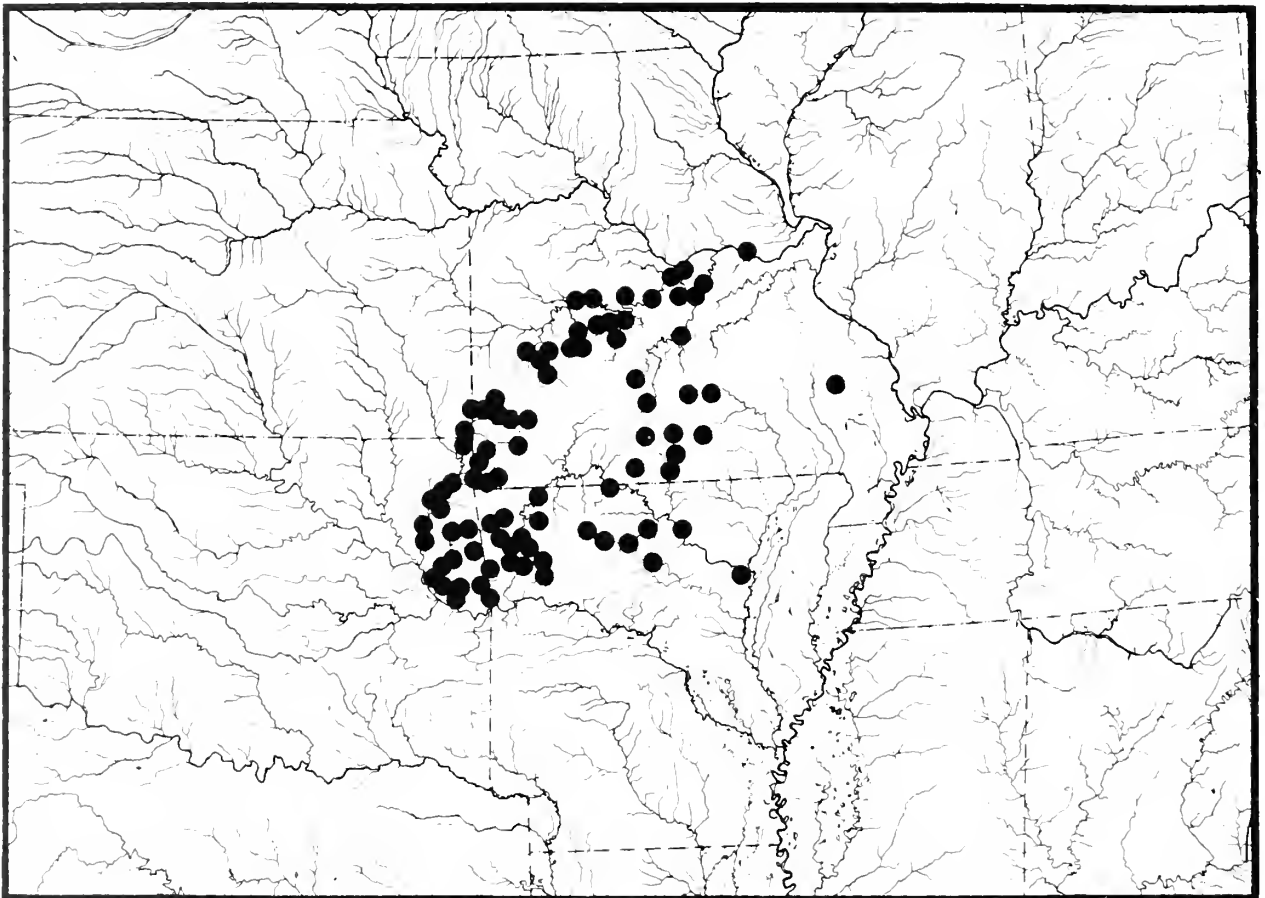
Order Perciformes
Family Percidae

TYPE LOCALITY: Osage River, MO (Agassiz 1854. Am. J. Sci. Arts 17:297-308, 353-69).

SYSTEMATICS: Subgenus *Oligocephalus*. Appears to be in species group with *E. boschungii*, *E. cragini*, and *E. pallididorsum* (Wall and Williams 1974. Tulane Stud. Zool. Bot. 18:172-82).



OK: Delaware Co., Spavinaw
Creek, 45 mm SL
(J. L. Harris).



DISTRIBUTION AND HABITAT: Ozark Upland of southeastern KS, southern MO, northeastern OK, and northern AR. Most abundant in spring runs or small creeks, but occasionally found in larger streams. Generally inhabits clear pools or backwaters where it hides under rocks, organic debris, vegetation, or undercut banks.

ADULT SIZE: 45-65 mm SL.

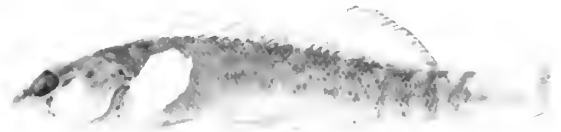
BIOLOGY: Specimens with breeding coloration have been taken in April and May. Reproductive habits unknown. Adults are often found in riffles during the spawning season.

Compiler: D. G. Cloutman. May 1978.

Etheostoma radiosum (Hubbs
and Black)
Orangebelly darter

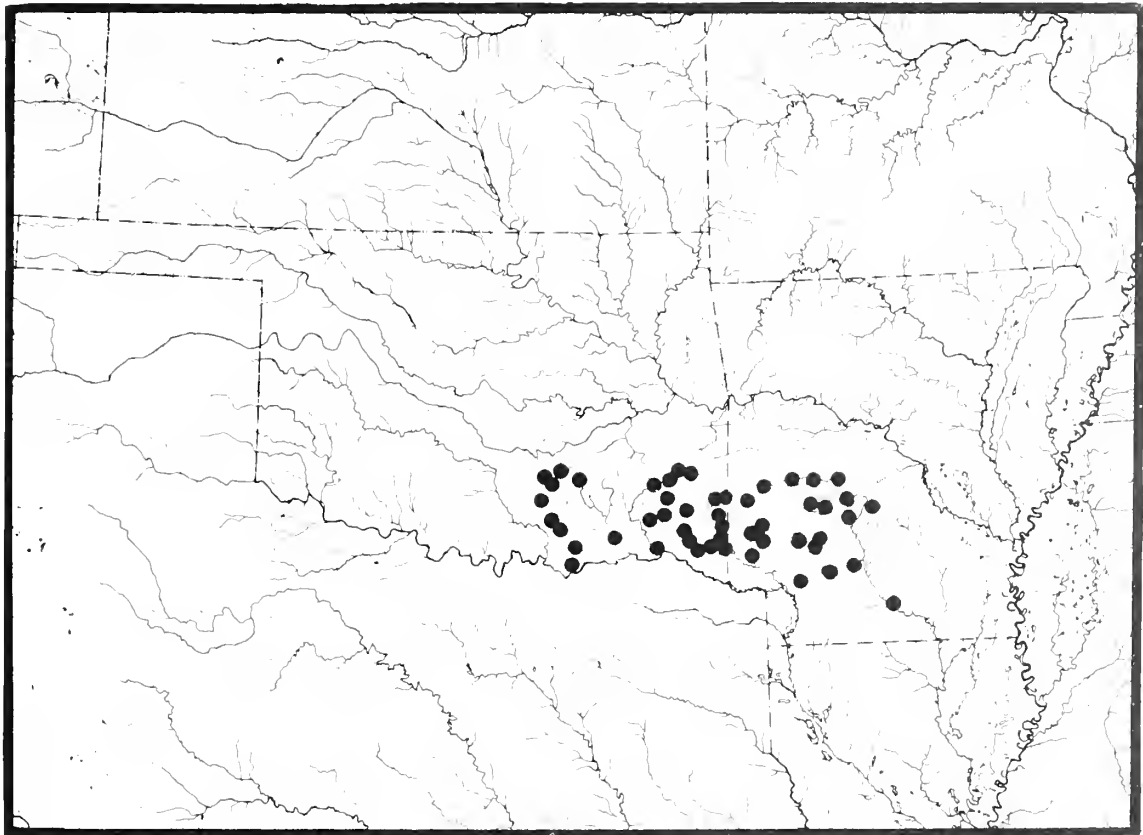
Order Perciformes
Family Percidae

TYPE LOCALITY: Sugar Loaf Creek, tributary of Caddo River, Ouachita River drainage, on U. S. hwy. 70, in T4S, R22W, Hot Springs Co., AR (Hubbs and Black 1941. *Ocas. Pap. Mus. Zool. Univ. Mich.* 429:1-29).



SYSTEMATICS: Subgenus *Oligocephalus*. Elevated from subspecies of *E. whipplei* by Moore and Rigney (1952. *Copeia*:7-15). Three subspecies, *E. r. radiosum*, *E. r. cyanorum*, and *E. r. paludosus* recognized by Moore and Rigney (1952). Species substantiated by Echelle et al. (1974. *Am. Midl. Nat.* 91:182-94) and Echelle et al. (1975. *Copeia*:197-204).

AR: Polk Co., Ouachita River,
41 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Red River drainage in southeastern OK and southwestern AR. Inhabits a variety of habitats ranging from high gradient streams to more sluggish lowland streams. Preferred habitat appears to be riffle areas of gravel-bottomed streams with moderate to high currents.

ADULT SIZE: 34-69 mm SL.

BIOLOGY: Scalet (1971. Ph.D. diss., Univ. Oklahoma) studied numerous aspects of life history of *E. r. cyanorum*. Hybridization studied by Branson and Campbell (1969.

Copeia:70-75), Echelle et al. (1974), Echelle et al. (1975), Linder (1955. *Am. Midl. Nat.* 54:173-91), and Linder (1958. *Trans. Kans. Acad. Sci.* 61:195-212). Data also available on parasites (Scalet 1971. *J. Parasitol.* 57: 900), food habits (Scalet 1972. *Am. Midl. Nat.* 87:515-22), reproduction (Scalet 1973a. *Am. Midl. Nat.* 89:156-65), stream movements (Scalet 1973b. *Southwestern Nat.* 17: 381-87), and predation (Scalet 1974. *Am. Midl. Nat.* 92:510-12).

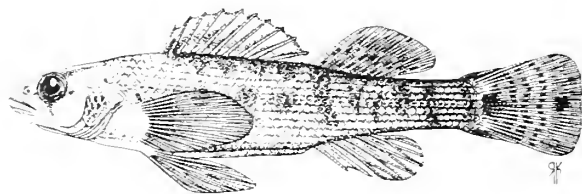
Compilers: C. G. Scalet and S. P. Platania.
October 1978.

Etheostoma rubrum Raney and
Suttkus
Bayou darter

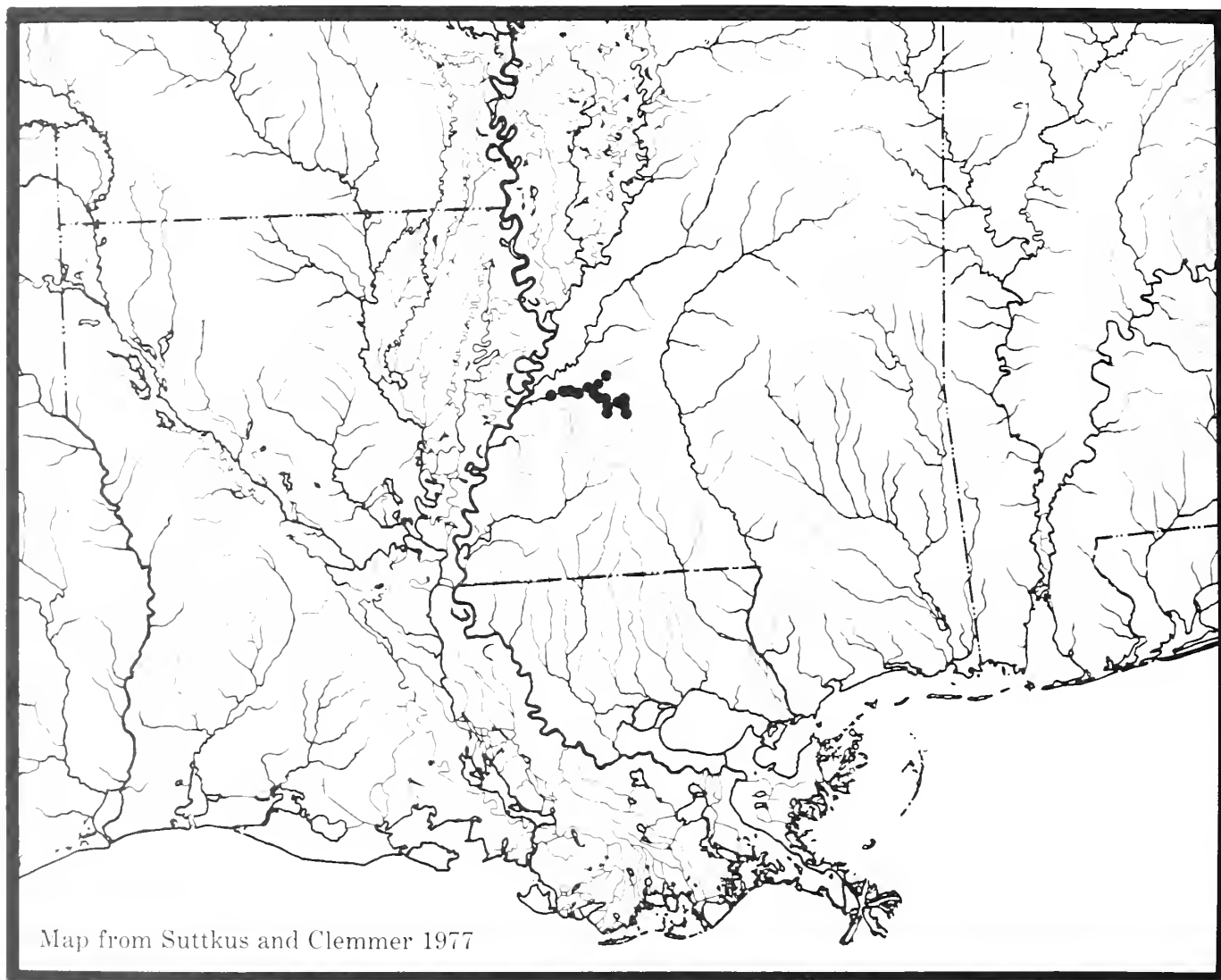
Order Perciformes
Family Percidae

TYPE LOCALITY: Bayou Pierre at jct. hwy. 18 and 27, 13.8 km sw of Utica, Copiah Co., MS (Raney and Suttkus 1966. Tulane Stud. Zool. Bot. 13:95-102).

SYSTEMATICS: Subgenus *Nothonotus*. Closest relative believed to be *E. moorei*.



MS: Copiah Co., Bayou Pierre.
30 mm SL (NCSM).



Map from Suttkus and Clemmer 1977

DISTRIBUTION AND HABITAT: Occurs only in Bayou Pierre drainage (an independent drainage flowing into the Mississippi River) of west-central MS, where it is known from over 25 closely adjacent localities. Prefers stable riffles of large gravel and rock; seldom occurs over shifting substrates (Suttkus and Clemmer 1977. Southeast. Fishes. Counc. Proc. 1:1-4). Habitat of Bayou Pierre system is markedly different from that of adjacent river systems and probably

accounts for the isolation of this species from its closest relatives. Never abundant, but occasionally occurs in moderate numbers in preferred habitat.

ADULT SIZE: ca. 40 mm SL maximum.

BIOLOGY: Nothing has been published except general observations on habitat.

Compiler: S. P. Platania. February 1978.

Etheostoma rufilineatum (Cope)
Redline darter

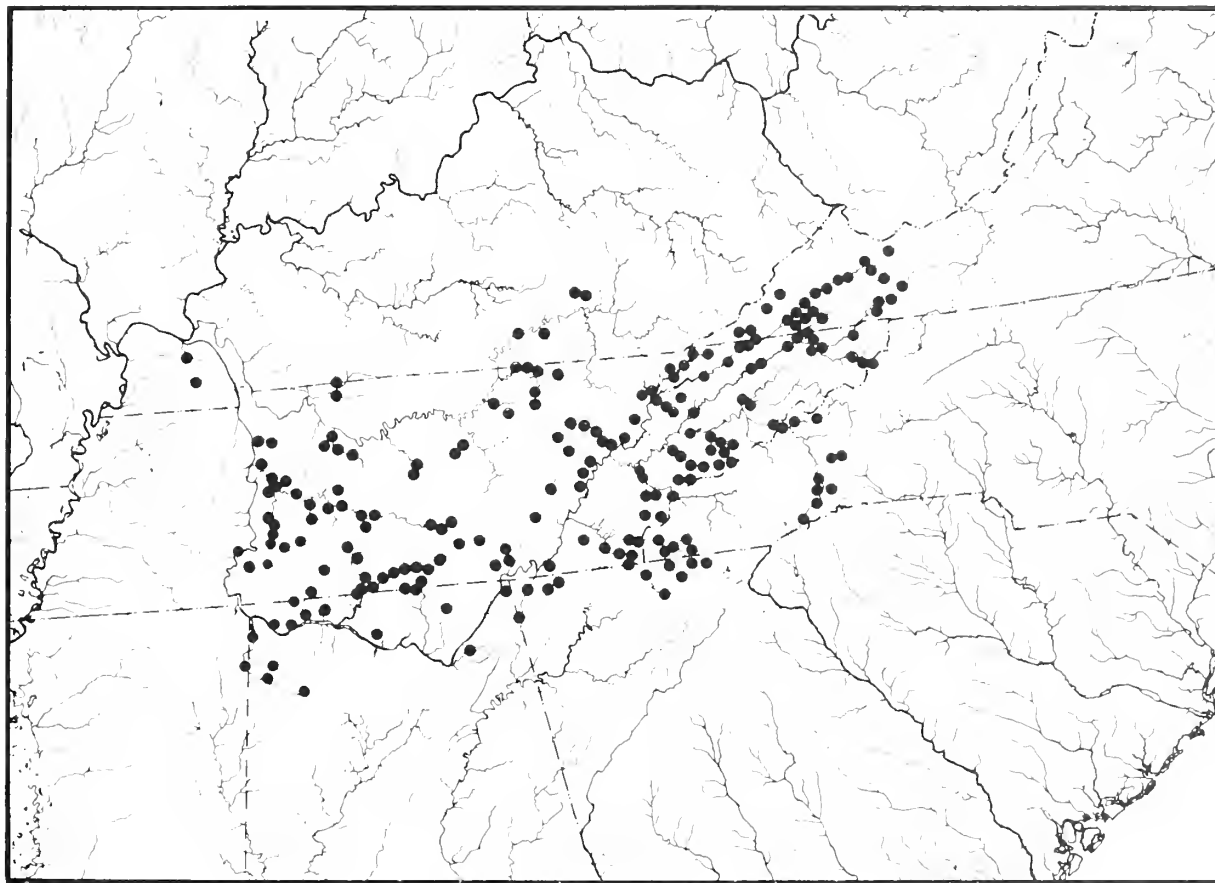
Order Perciformes
Family Percidae

TYPE LOCALITY: Warm Springs Creek, tributary to French Broad River, Madison Co., NC (Cope 1870. Proc. Am. Philos. Soc. 11: 448-95).

SYSTEMATICS: Subgenus *Nothonotus*. Most closely related to *E. bellum* and *E. camurum* species group (Zorach 1972. Copeia:427-47).



VA: Wise Co., South Fork
Powell River, male, 50 mm SL
(A. E. Spreitzer).



DISTRIBUTION AND HABITAT: Restricted to the Tennessee and Cumberland river drainages. Absent in Cumberland drainage in or upstream from Big South Fork. Known from only two western tributaries to the lower Tennessee River, Stewman Creek, Decatur Co., TN, and West Fork Clarks River, Marshall and Calloway cos., KY. Inhabits swift shallow riffles in clear streams and small rivers, where typically abundant.

ADULT SIZE: 63-76 mm SL.

BIOLOGY: Stiles (1972. Ph.D. diss., Univ. Tennessee) discussed biology of this species and reported spawning in riffles in late spring and early summer, with females burying eggs under the sand. Midge larvae (Chironomidae) dominated in diet of adults.

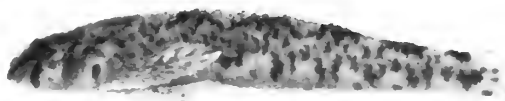
Compiler: D. A. Etnier. June 1978.

Etheostoma rupestre Gilbert and
Swain
Rock darter

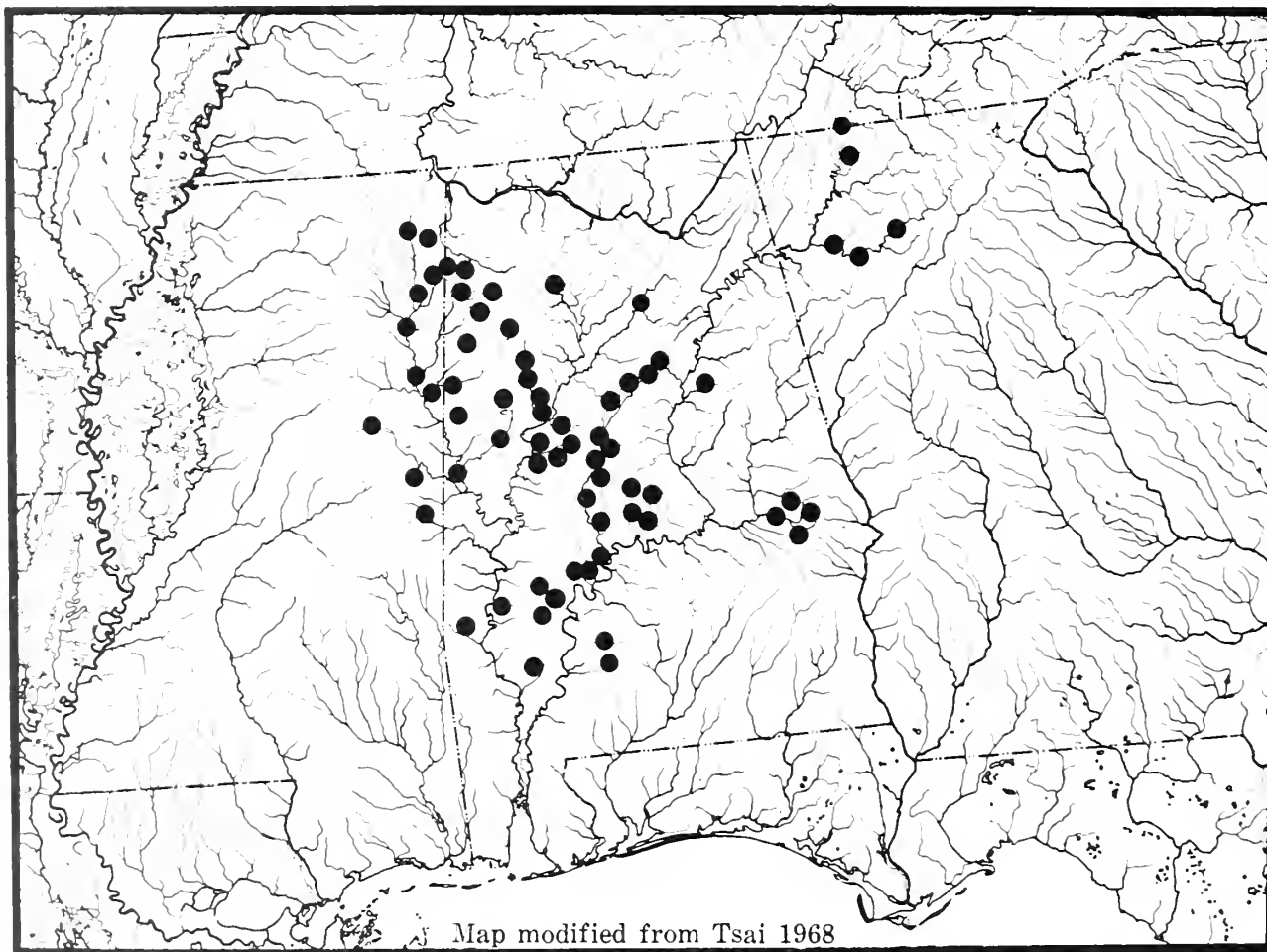
Order Perciformes
Family Percidae

TYPE LOCALITY: North River, tributary of Black Warrior River, near Tuscaloosa, AL (Gilbert and Swain in Gilbert 1888. Proc. U. S. Natl. Mus. [1887] 10:47-64).

SYSTEMATICS: Subgenus *Etheostoma*. Superficially resembles *E. blennioides*, *E. histrio*, and *E. zonale* (Tsai 1968, Copeia:346-53). Divisible into two populations based on scale counts, one from Alabama River system and other from Tombigbee River system, exclusive of North River (Tsai 1968).



AL: Bibb Co., Cahaba River,
36 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Restricted to Alabama and Tombigbee river systems of Mobile River drainage. In swift riffles over rocky bottom or bed rock. Common in Black Warrior and Cahaba systems of AL, rarer and more spotty elsewhere, particularly in lower parts of Mobile Bay drainage.

ADULT SIZE: 50-70 mm SL.

BIOLOGY: No information available.

Compiler: C. H. Hocutt. October 1978.

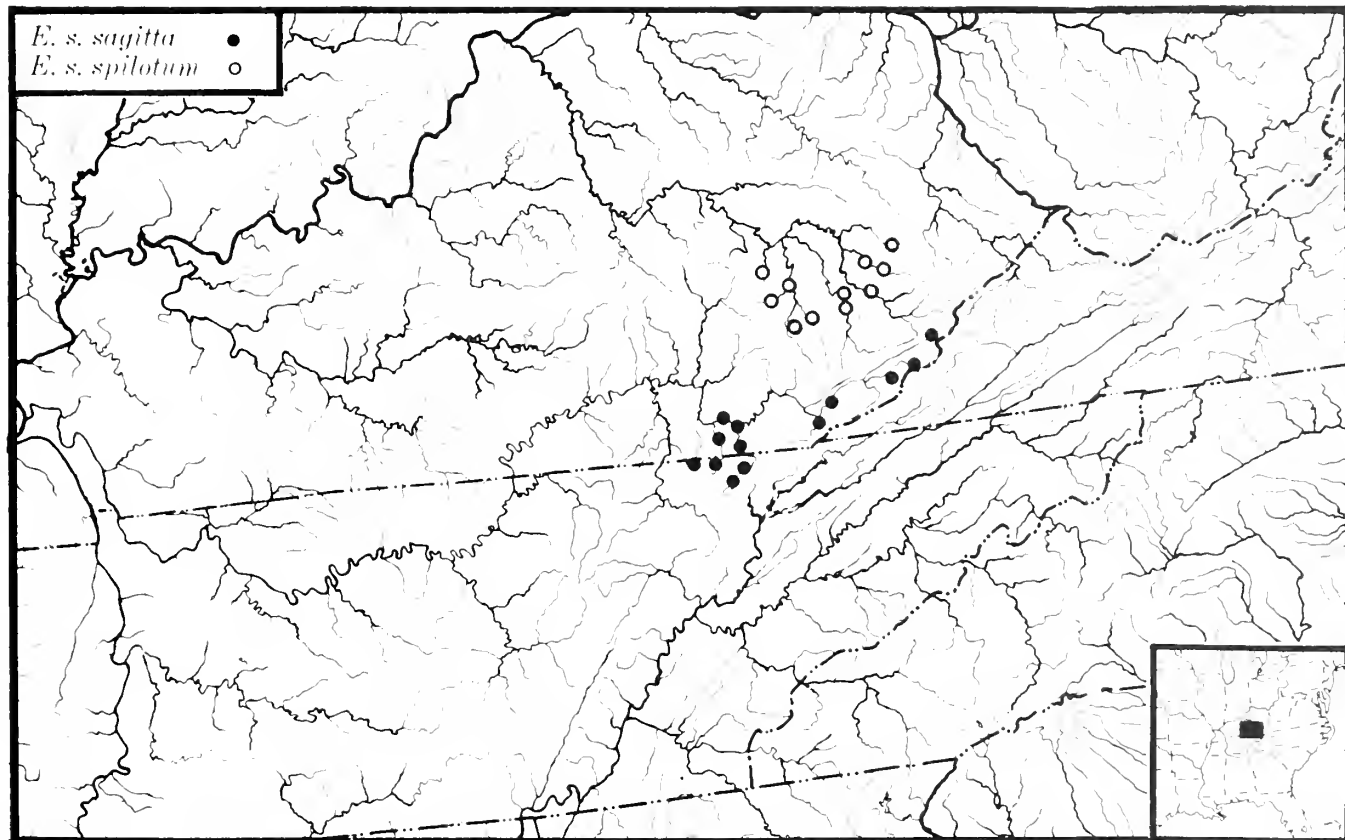
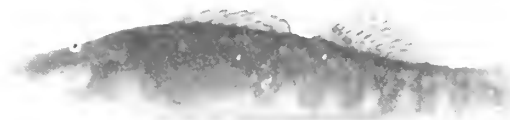
Etheostoma sagitta (Jordan and Swain)
Arrow darter

Order Perciformes
Family Percidae

TYPE LOCALITY: Wolf Creek (tributary to Clear Fork of Cumberland River), near Pleasant View, Whitley Co., KY (Jordan and Swain 1883. Proc. U.S. Natl. Mus. 6: 248-51).

SYSTEMATICS: Subgenus *Litocara*. Bailey (1948. Copeia: 77-85) and Kuehne and Bailey (1961. Copeia: 1-8) reviewed systematics. Bailey (1948) originally regarded *E. spilotum* from Kentucky River system as valid species, but Kuehne and Bailey (1961) downgraded

TN: Scott Co., Perkins Creek.
69 mm SL (NCSM).



it to subspecies of *E. sagitta*. *Etheostoma sagitta* and Ozarkian *E. nianquac* form closely related species pair. Subgenus *Litocara*, originally proposed by Bailey (1948), synonymized with subgenus *Oligocephalus* by Bailey and Gosline (1955. Misc. Publ. Mus. Zool. Univ. Mich. 93:1-44) and subsequently re-elevated to subgeneric status, apparently by Page and Whitt (1973. Comp. Biochem. Physio. 44B: 611-23).

DISTRIBUTION AND HABITAT: Restricted distribution in headwaters of Kentucky River drainage, southeast KY (*E. s. spilotum*), and Cumberland River drainage, southeast KY and northeast TN (*E. s. sagitta*). Distribution in Cumberland almost entirely limited to area above Cumberland Falls; presence in two tributaries draining into

Cumberland River below Falls may be result of natural stream capture or, conversely, of man-induced stream alterations (Comiskey and Etnier 1972. J. Tenn. Acad. Sci. 47: 140-45). Presence in Kentucky drainage result of natural stream transfer from Cumberland (Kuehne and Bailey 1961). Typically in flowing pools (often intermittent during low-water periods) of very small (1-2 m wide) headwater streams containing gravel-rubble substrate. Moderately common.

ADULT SIZE: to 84 mm SL.

BIOLOGY: No published studies. Bailey (1948) noted collection of gravid females on 8 April (water temperature, 9.4°C) and assumed April spawning.

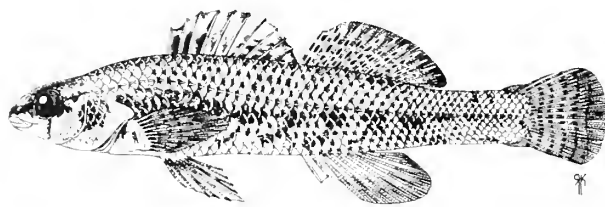
Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Etheostoma saludae (Hubbs and
Cannon)
Saluda darter

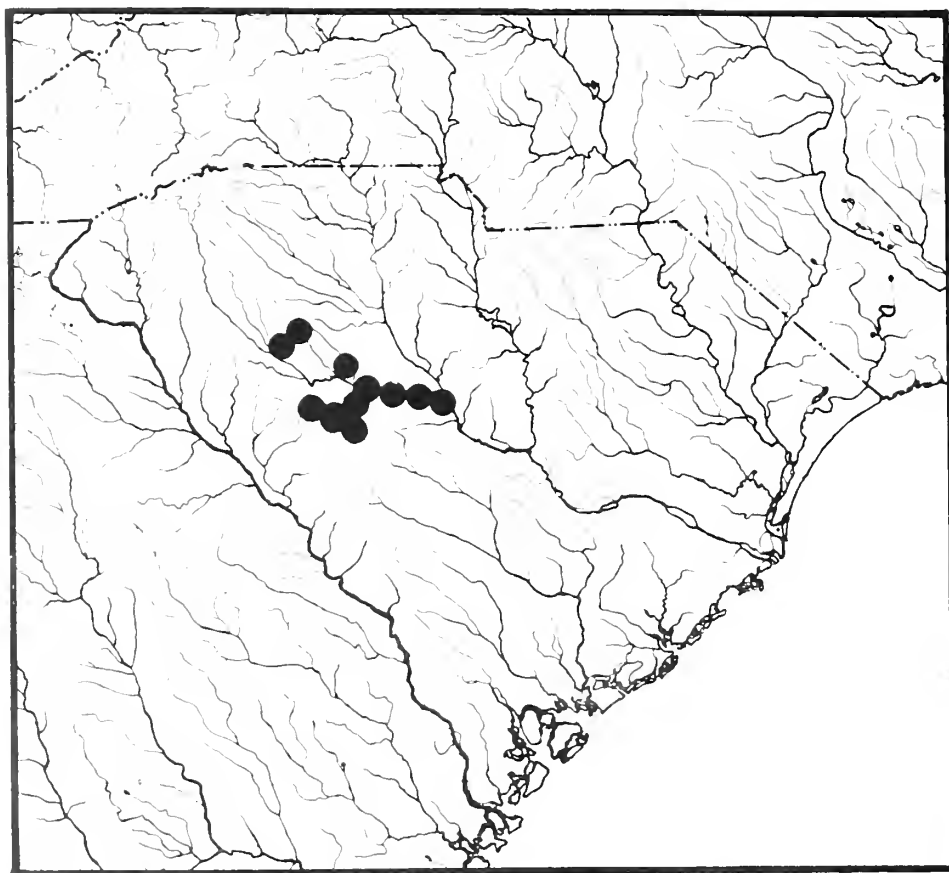
Order Perciformes
Family Percidae

TYPE LOCALITY: Richland Creek, tributary to Lake Murray, 16 km se of Saluda, Saluda Co., SC (Hubbs and Cannon 1935. Misc. Publ. Mus. Zool. Univ. Mich. 30:1-93).

SYSTEMATICS: Subgenus *Hololepis*. Collette (1962. Tulane Stud. Zool. 9:115-211) reviewed species. Closest affinities with *E. collis*, from which it differs principally in having interorbital pores.



SC: Saluda Co., tributary,
Little Saluda River, male,
40 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Endemic to Saluda and Broad rivers, tributaries of Congaree River, Santee drainage, SC, on or above Fall Line. In small (1.5-4.5 m wide, 0.6-1.2 m deep) woodland Piedmont streams with slow to moderate current and substrate composed of sand, gravel, and bedrock (Collette 1962).

ADULT SIZE: 30-43 mm SL.

BIOLOGY: Males tuberculate in spring (Collette 1962), hence apparently spawns in that season.

Compiler: J. R. Stauffer, Jr. September 1978.

Etheostoma sellare (Radcliffe and
Welsh)
Maryland darter

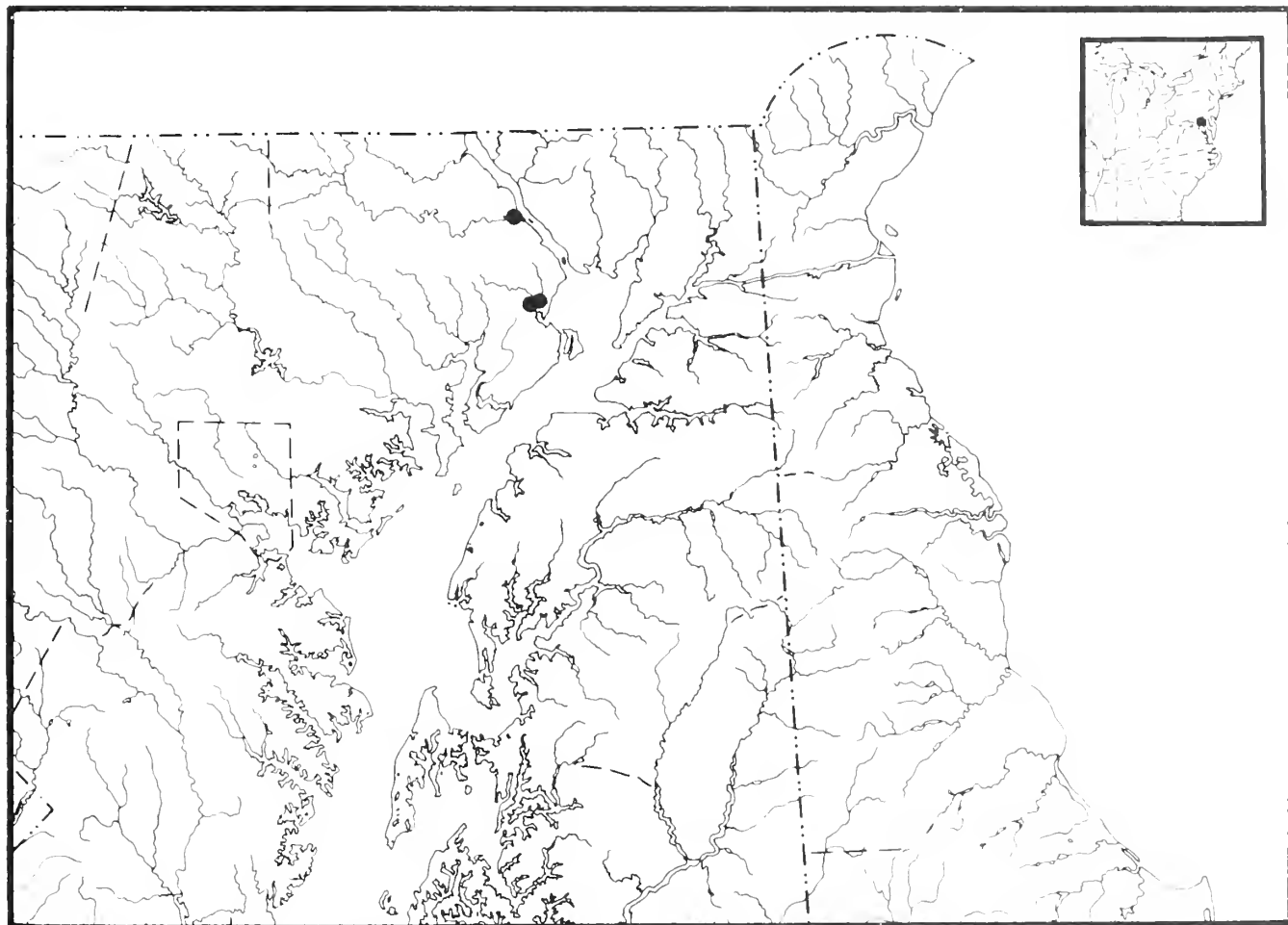
Order Perciformes
Family Percidae

TYPE LOCALITY: Swan Creek, upper Chesapeake Bay drainage, near Havre de Grace, MD (Radcliffe and Welsh 1913, Bull. U.S. Bur. Fish [1912] 32:29-32).

SYSTEMATICS: Divergent species currently in subgenus *Etheostoma*, and may warrant erection of new monotypic subgenus. Knapp (1976, Proc. Biol. Soc. Wash. 89:99-117) reviewed systematics and ecology. Apparent relict of ancient Atlantic slope fauna.



MD: Harford Co., Deer Creek.
57 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Reported from only three sites, all in Harford Co., MD: Swan Creek, Gashey's Run, and Deer Creek. Taken from swift riffles in extreme lower sections of these streams on Coastal Plain (Knapp 1976).

BIOLOGY: Knapp (1976) summarized information on breeding and feeding habits from the few specimens available. Radiographs indicated that 28 of 35 specimens taken on 10 November 1968 had snails in digestive tract. Snails and caddis fly larvae appear to be major constituents of fall diet.

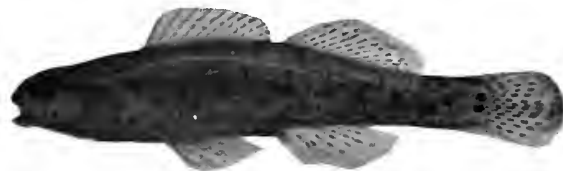
ADULT SIZE: 45-70 mm SL.

Compilers: C. H. Hocutt and J. R. Stauffer, Jr. July 1978.

Etheostoma serriferum (Hubbs
and Cannon)
Sawcheek darter

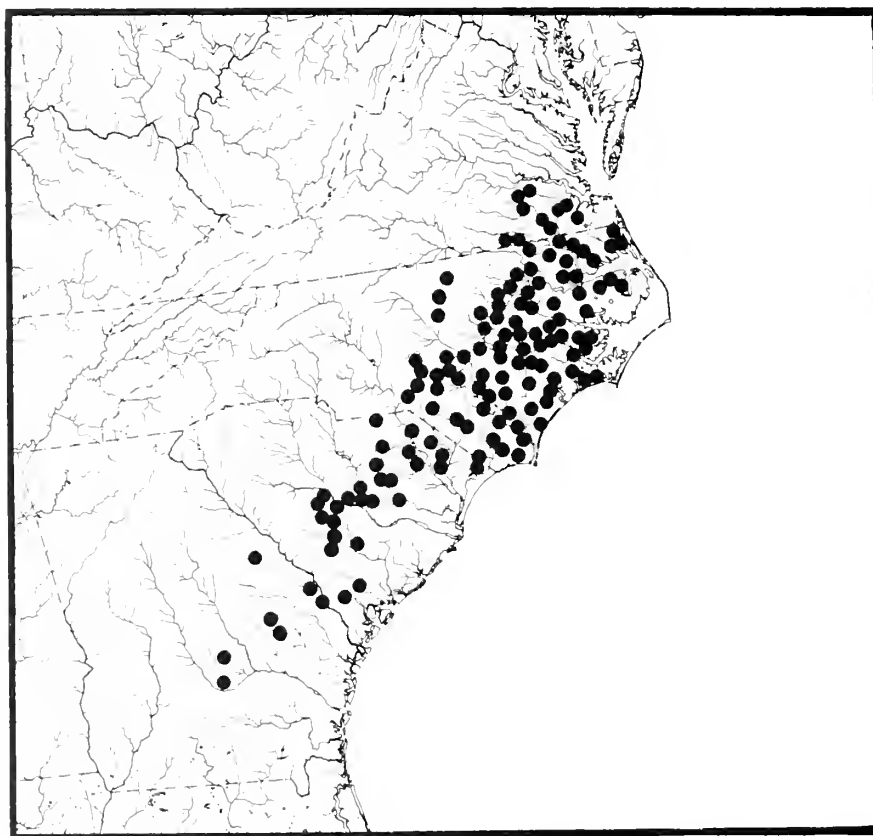
Order Perciformes
Family Percidae

TYPE LOCALITY: Buffalo Creek, at Wendell, Wake Co., NC (Hubbs and Cannon 1935. Misc. Publ. Mus. Zool. Univ. Mich. 30:1-93).



SYSTEMATICS: Most primitive member of subgenus *Hololepis*. Collette (1962. Tulane Stud. Zool. 9:115-211) reviewed species.

NC: Wake Co., Buffalo Creek,
51 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Atlantic Coastal Plain from Dismal Swamp, VA, to Altamaha drainage, GA. Above Fall Line known only from Mud Creek, Cape Fear drainage, Durham, NC (Collette 1962). Apparently prefers better oxygenated, more open, and less sluggish waters than other members of *Hololepis*. Sometimes common. Detailed information on habitat in Collette (1962).

ADULT SIZE: 40-60 mm TL.

BIOLOGY: Frequent fish associates, food and behavior in aquaria noted by Collette (1962).

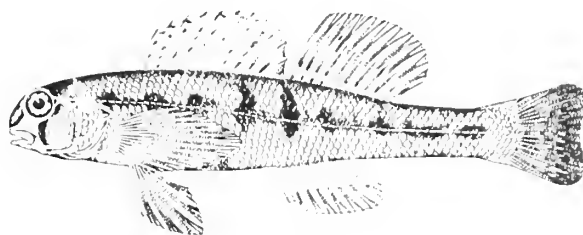
Compiler: C. H. Hocutt. September 1978.

Etheostoma simoterum (Cope)
Tennessee snubnose darter

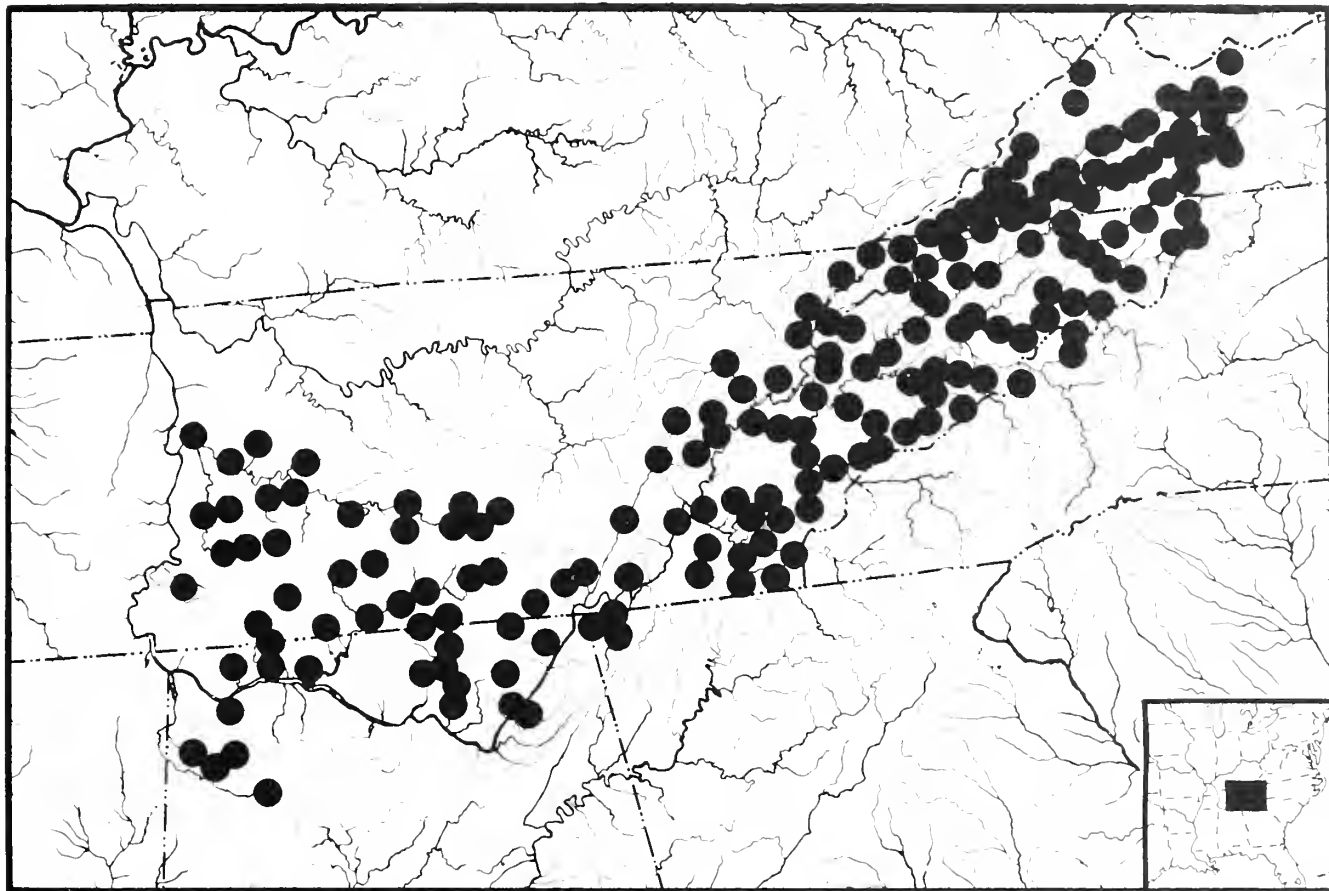
Order Perciformes
Family Percidae

TYPE LOCALITY: Holston River, VA (Cope 1868. J. Acad. Nat. Sci. Phila. 6:207-47).

SYSTEMATICS: Subgenus *Ulocentra*. Most closely related to and probably conspecific with *E. atripinne*.



TN: Arnwine Spring, Mount Verd, ca. 57 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Upper Tennessee River drainage of VA, TN, and northwest GA, downstream to mouth of Duck River (only *Ulocentra* in extreme upper Tennessee River system). Virtual absence from upper Tennessee drainage of NC is not a collecting artifact, and may be associated with abrupt gradient change at the state line (Gilbert and Seaman 1973. ASB Bull. 20:55). Apparent absence from southern tributaries to Tennessee River (excepting Bear Creek system) in AL may be a collecting artifact. Absent from western tributaries to lower Tennessee River, where replaced by an additional undescribed species and a few populations of *E. duryi*. One of the most abundant

and widespread darters in its range, it occurs from small streams to moderate rivers. Typically in shallow water with moderate current over gravel substrates.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Breeds in late spring. Where sympatric with *E. duryi* or its undescribed relative, *E. simoterum* adults are typically associated with swifter currents than are either of these species.

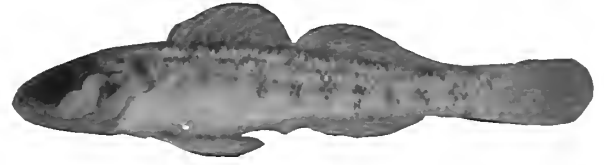
Compiler: D. A. Etnier. June 1978.

Etheostoma smithi Page and
Braasch
Slabrock darter

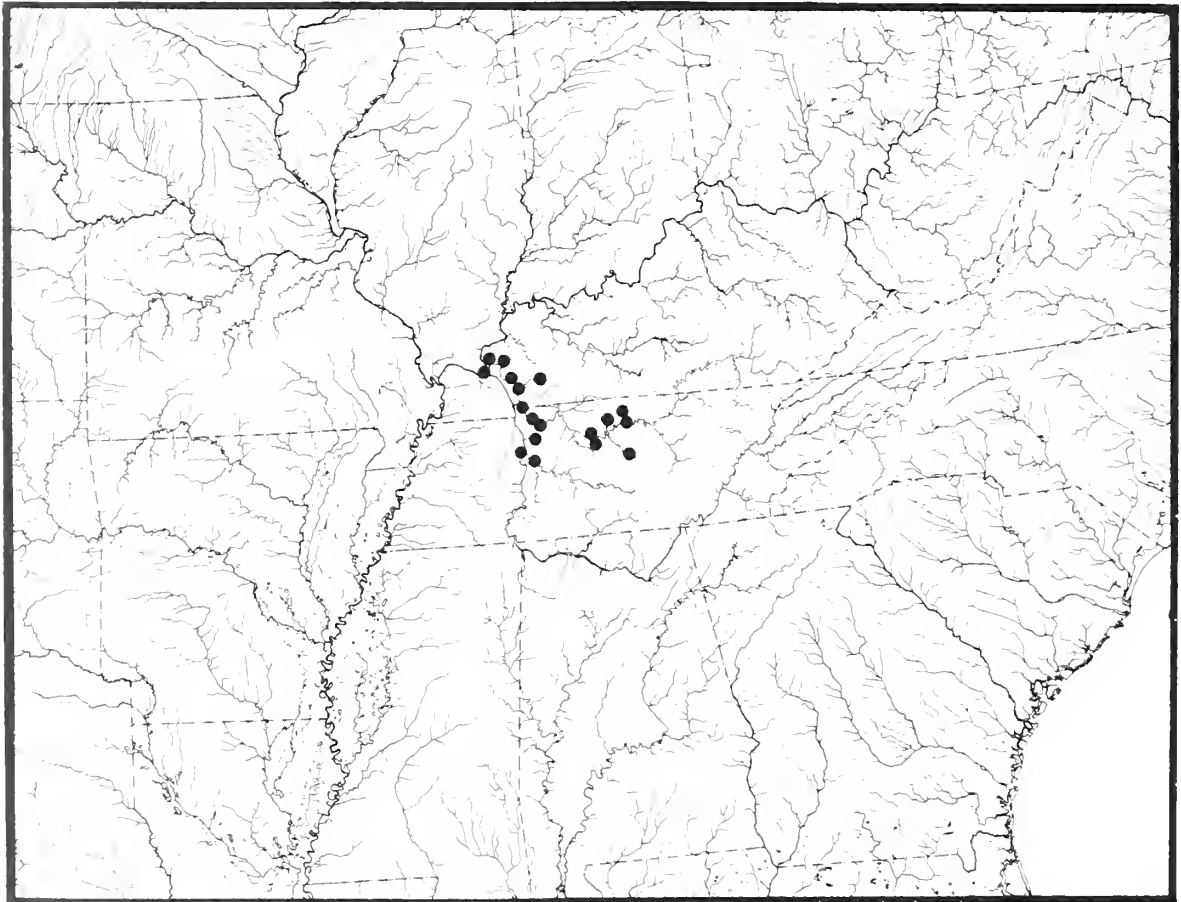
Order Perciformes
Family Percidae

TYPE LOCALITY: Ferguson Creek, at the route 70 bridge 3 km e Smithland, Livingston Co., KY (Page and Braasch 1976. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 60:1-18).

SYSTEMATICS: Subgenus *Catonotus*. Closest relatives are other barcheek darters: *E. barbouri*, *E. obcyense*, *E. striatulum*, and *E. virgatum* (Page 1975. Copeia:782-84; Page and Braasch 1976). Geographic variation discussed by Page and Braasch (1976).



KY: Livingston Co., Ferguson Creek, male, 52 mm SL (INHS).



Map modified from Page and Braasch (1976)

DISTRIBUTION AND HABITAT: Generally uncommon in tributaries of lower Cumberland River, TN and KY, from mouth of Cumberland River to near Caney Fork in north-central TN, and in tributaries of lower Tennessee River, TN, from Duck River north. Occupies slab-rock pools of small to large streams.

BIOLOGY: Page and Burr (1976. Ill. Nat. Hist. Surv. Biol. Notes 99:1-12) discussed life history in Ferguson Creek, KY. Spawns April to mid-June on undersides of slab rocks. Lives maximum of two years. Diet mostly immature insects and small crustaceans. Page and Schemske (1978. Copeia: 406-12) examined competition with other *Catonotus*.

ADULT SIZE: 30-52 mm SL.

Compiler: L. M. Page. December 1978.

Etheostoma spectabile (Agassiz)
Orangethroat darter

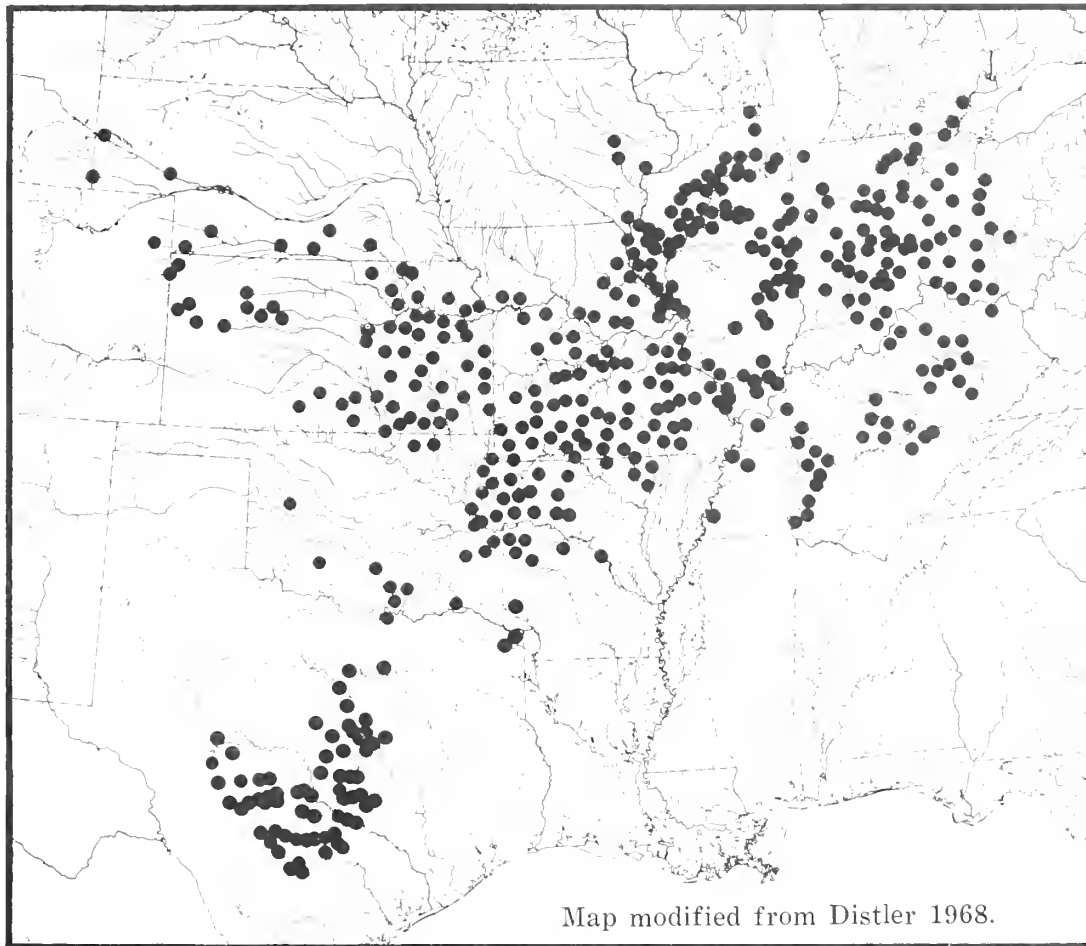
Order Perciformes
Family Percidae

TYPE LOCALITY: Osage River, MO (Agassiz 1854. Am. J. Sci. Arts [2nd ser.] 17:297-308, 353-69).

SYSTEMATICS: Subgenus *Oligocephalus*. Distler (1968. Univ. Kans. Sci. Bull. 48:143-208) recognized five subspecies: *E. s. fragi*, *E. s. pulchellum*, *E. s. spectabile*, *E. s. squamosum*, and *E. s. uniporum*. Wiseman et al. (1978. Copeia:320-27) compared electrophoretic patterns of the subspecies, and their results seem to support Distler (1968).



OK: Delaware Co., Arkansas
drainage, Spivnaw Creek, 54
mm SL (NCSM).



Map modified from Distler 1968.

DISTRIBUTION AND HABITAT: Inhabits hardwater, gravelly streams of Edwards, Ozark, and Interior Low plateaus and adjacent Central Lowlands of North America (Distler 1968). More tolerant of turbid waters and silted bottoms, and inhabits smaller streams than does its close relative *E. caeruleum* (Trautman 1957. *The Fishes of Ohio*). Avoids streams with continuous strong flow where conditions favor *E. caeruleum* (Pflieger 1975. *The Fishes of Missouri*).

ADULT SIZE: 30-64 mm SL.

BIOLOGY: Winn (1958. Am. Midl. Nat. 59:190-212) studied reproductive behavior. Hubbs et al. (1968. Southwest. Nat. 13:301-23) studied fecundity and egg size. Collette (1965. Proc. U.S. Natl. Mus. 117:567-614) examined breeding tubercles. Fry have been found associated with nests of *Micropterus salmoides* (Pflieger 1966. Copeia:139-40). An acanthocephalan intestinal parasite was described by Oettinger and Buckner (1976. J. Parasitol. 62:237-41).

Compiler: J. C. Bruner. March 1978.

Etheostoma squamiceps Jordan
Spottail darter

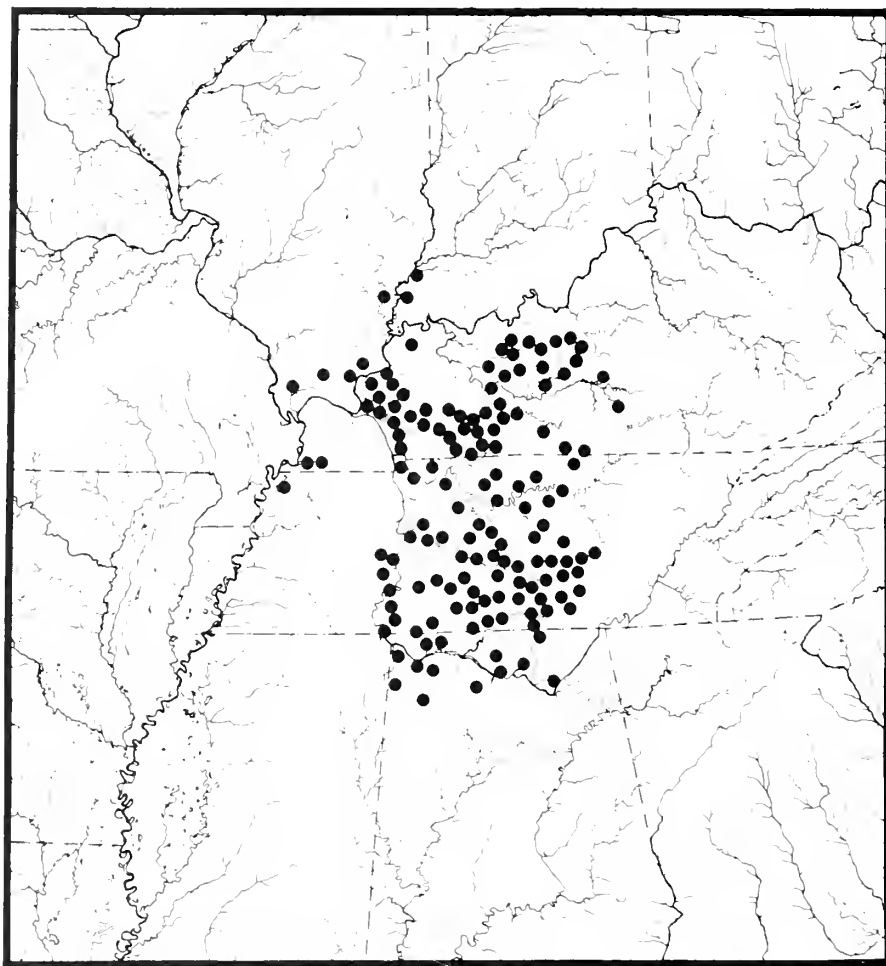
Order Perciformes
Family Percidae

TYPE LOCALITY: Russellville, Logan Co., KY (Jordan 1877. U. S. Natl. Mus. Bull. 10: 5-68).

SYSTEMATICS: Subgenus *Catonotus*. Closest relative is *E. neopterum* (Howell and Dingerkus 1978. Bull. Ala. Mus. Nat. Hist. 3:13-26). *Etheostoma squamiceps* is a complex of undescribed species or subspecies (Page 1975. Copeia:782-84; Howell and Dingerkus 1978).



TN: Davidson Co., Richland Creek, male, 71 mm SL (INHS).



DISTRIBUTION AND HABITAT: Common in slab riffles and pools of small to moderate-sized streams from lower Tennessee River drainage, AL and MS, north to Green River drainage of KY, tributaries of Ohio River in southern IL and northwest KY, and tributaries of Wabash River in southwest IN. Also present in tributaries of Mississippi River in southwest KY and northeast TN.

ADULT SIZE: 35-87 mm SL.

BIOLOGY: Page (1974. Ill. Nat. Hist. Surv. Biol. Notes 89:1-20) discussed life history in Big Creek, IL, and Ferguson Creek, KY. Spawns late March to May or June on undersides of slab rocks. Lives to maximum of three and a half years. Feeds primarily on immature insects and crustaceans. Howell and Dingerkus (1978) compared life history to that of *E. neopterum*. Page and Schemske (1978. Copeia: 406-12) examined competition with other *Catonotus*.

Compiler: L. M. Page. December 1978.

***Etheostoma stigmaeum* (Jordan)**
Speckled darter

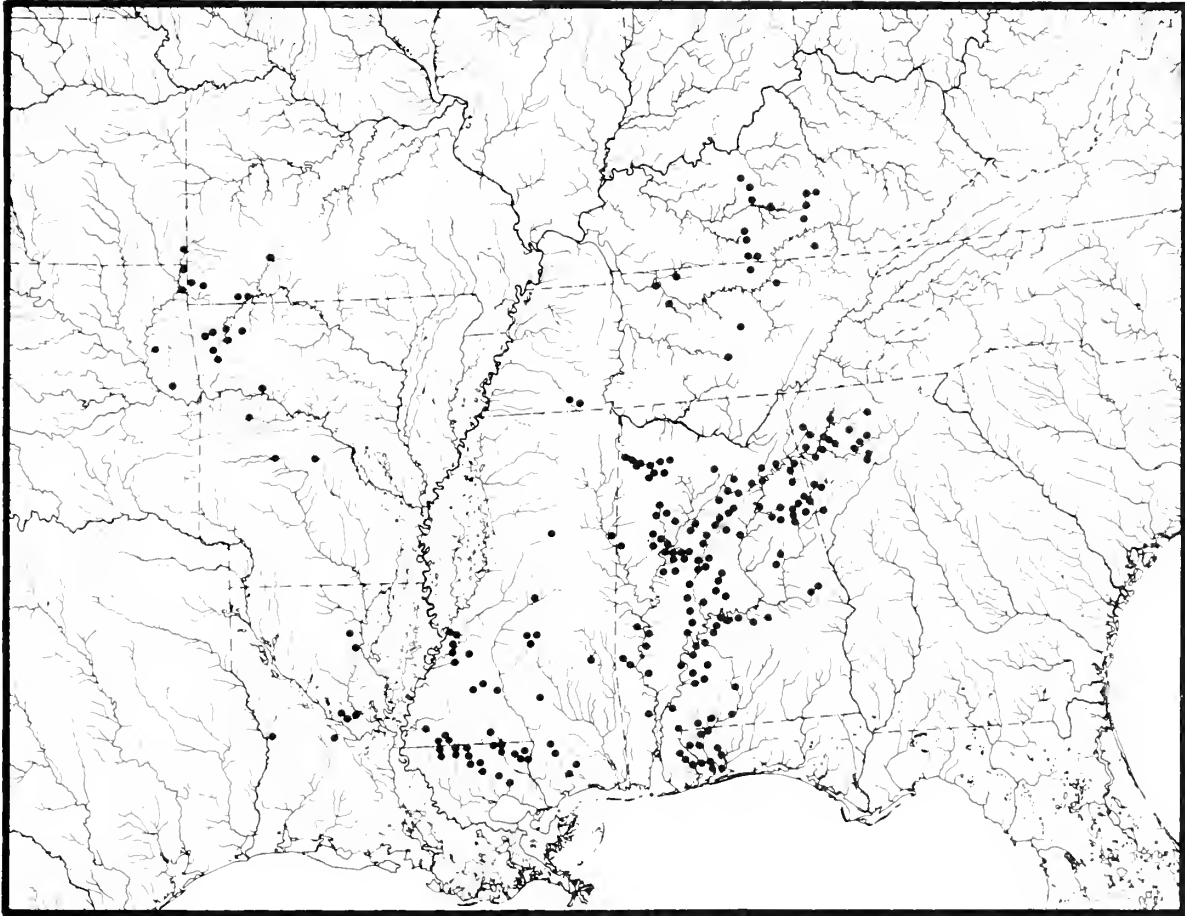
Order Perciformes
Family Percidae



TYPE LOCALITY: Etowah and Oostanaula rivers, GA (Jordan 1877. Ann. N.Y. Lyceum Nat. Hist. [1876] 11:307-77). Type locality restricted by Bailey et al. (1954. Proc. Acad. Nat. Sci. Phila. 106:109-64) to Etowah River (tributary of Coosa River) near Rome, Floyd Co., GA.

SYSTEMATICS: Subgenus *Doration* (Howell 1968. Ph.D. diss., Univ. Alabama). Very closely related to *E. jessiae* and *E. meadiae* of Tennessee River drainage. These, along with two undescribed species from Cumberland River drainage, form close-knit species complex. Hybridizes with *E. jessiae* in Little Bear Creek, Franklin Co., AL.

AL: Jefferson Co., Five Mile Creek, male, 47 mm SL (W. M. Howell).



Map modified from Howell 1968

DISTRIBUTION AND HABITAT: Most major Gulf slope drainages from Pensacola Bay drainage of southwest AL and northwest FL west to Sabine River drainage in LA; north in Mississippi River basin through LA, MS, and western TN to Ozark region of AR, OK, KS, and MO and into Cumberland and Green river drainages of TN and KY. Generally found in relatively small to moderate-sized streams with sand and gravel bottom. Distributed throughout streams in pools and riffles. Avoids sluggish streams of low gradient.

ADULT SIZE: 30-50 mm SL.

BIOLOGY: Winn (1958a. Am. Midl. Nat. 59:190-212; 1958b. Ecol. Monogr. 28:155-91) studied reproductive behavior and ecology. In AL, Howell and Boschung (1966. Am. Midl. Nat. 76:510-14) reported males in full breeding colors on 3 April 1965 with colors beginning to wane in late May.

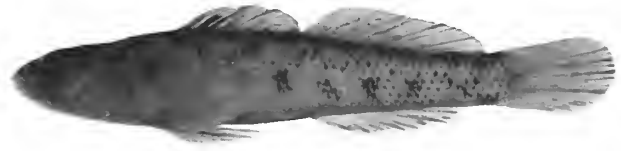
Compiler: W. M. Howell. October 1978.

Etheostoma striatulum Page and
Braasch
Striated darter

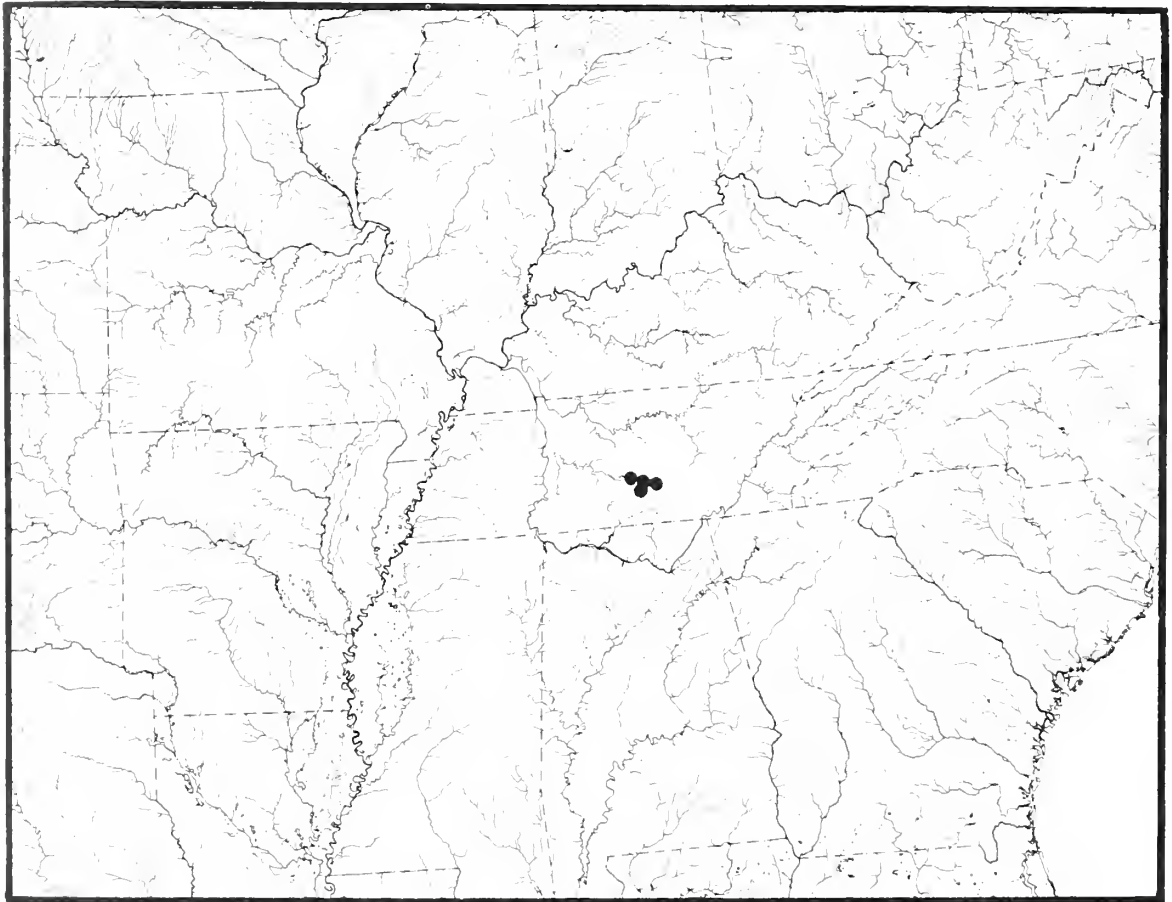
Order Perciformes
Family Percidae

TYPE LOCALITY: Wartrace Creek at the Tennessee route 82 bridge, 2 km e Bell Buckle, Bedford Co., TN (Page and Braasch 1977, Occas. Pap. Mus. Nat. Hist. Univ. Kans. 63:1-18).

SYSTEMATICS: Subgenus *Catonotus*. Closest relatives are other barcheek darters: *E. barbouri*, *E. obeyense*, *E. smithi*, and *E. virgatum* (Page and Braasch 1977).



TN: Bedford Co., Hurricane Creek, 45 mm SL (R. T. Bryant, Jr.).



Map modified from Page and Braasch (1977)

DISTRIBUTION AND HABITAT: Uncommon in tributaries of Duck River, Tennessee River drainage, Bedford and Marshall cos., TN. In slab-rock pools of small to moderate-sized streams.

BIOLOGY: Page and Schemske (1978, Copeia:406-12) examined competition with other *Catonotus*.

ADULT SIZE: 30-47 mm SL.

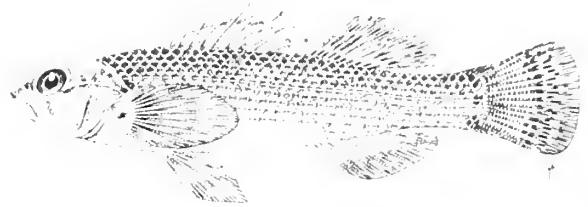
Compiler: L. M. Page, December 1978.

Etheostoma swaini (Jordan)
Gulf darter

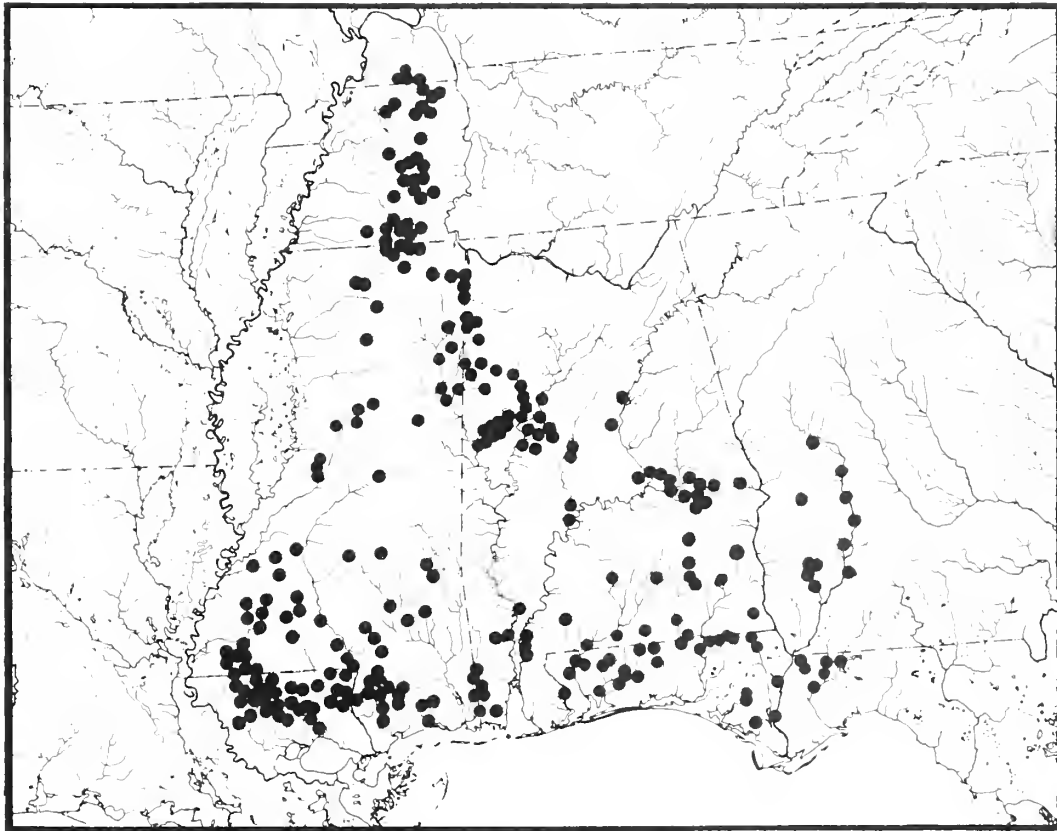
Order Perciformes
Family Percidae

TYPE LOCALITY: Tributary of Pearl River at Monticello, Lawrence Co., MS (Jordan 1884. Proc. U.S. Natl. Mus. 7:477-80).

SYSTEMATICS: Subgenus *Oligocephalus*. In *E. asprigene* species group with derivatives *E. ditrema* and *E. nuchale* (Ramsey and Suttkus 1965. Tulane Stud. Zool. 12:65-77). May also be closely related to *E. hopkinsi*.



FL: Holmes Co., tributary to Pea River, 42 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Small to medium-sized, sandy or vegetated streams of Gulf slope drainages, from Lake Pontchartrain, LA, to Ochlockonee drainage, FL, and in many eastern tributaries to Mississippi River from Buffalo Bayou, MS, north to Obion system, TN and KY. Also present in Bear Creek, northeast MS, a Tennessee River tributary. Occupies more upstream areas where range overlaps with *E. asprigene*.

ADULT SIZE: 45-60 mm SL.

BIOLOGY: Unknown. Nuptial specimens captured during April in FL and TN.

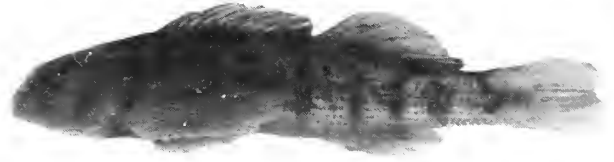
Compiler: W. C. Starnes. May 1978.

Etheostoma swannanoa Jordan
and Evermann
Swannanoa darter

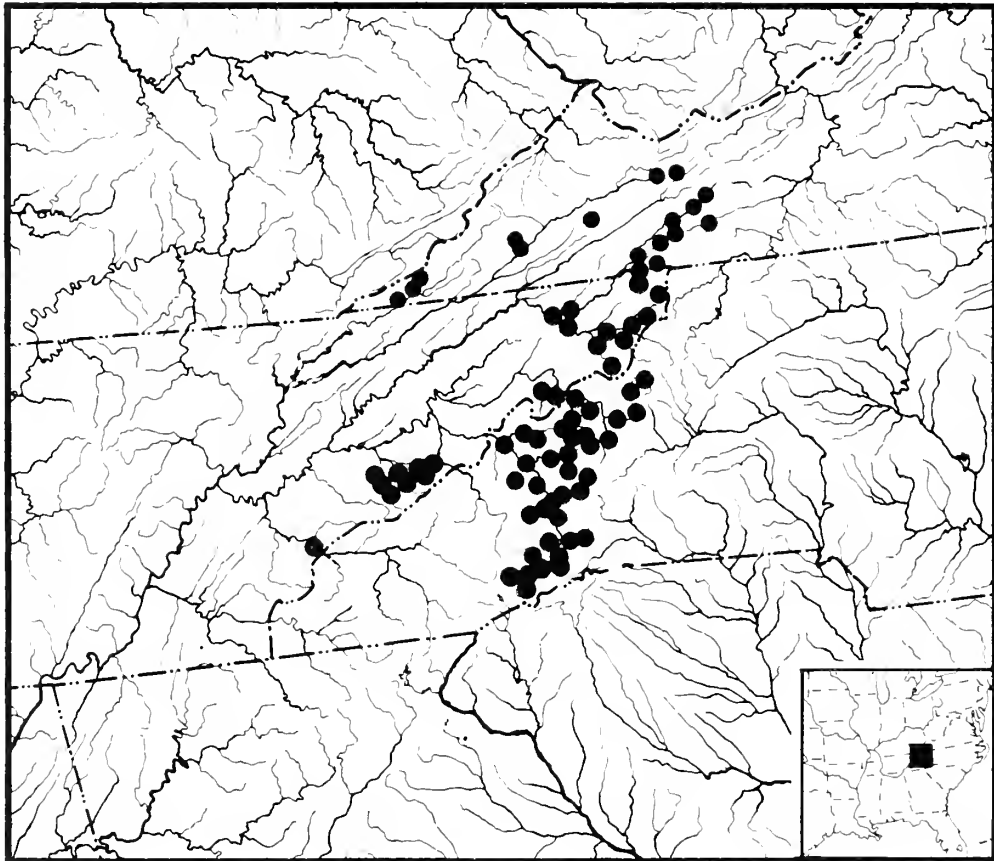
Order Perciformes
Family Percidae

TYPE LOCALITY: South Fork Holston River at Holston Mills, VA (Jordan and Evermann *in* Jordan 1889. Proc. U.S. Natl. Mus. 11:351-62).

SYSTEMATICS: Subgenus *Etheostoma*. Member of *E. thalassinum* species group, along with *E. inscriptum* (Richards 1966. Copeia:823-38).



NC: Buncombe Co., North fork of Swannanoa River, 52 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Confined to Tennessee River tributaries of Blue Ridge region, in swift riffles with cobble-boulder substrate. Abundant in French Broad and Little Pigeon systems and a few Holston River tributaries; much less common in Little Tennessee and Clinch systems. More widespread and abundant in NC than in TN.

ADULT SIZE: 65-75 mm SL.

BIOLOGY: No published information. Spawns in swift riffles during April in Little Pigeon system.

Compiler: W. C. Starnes. May 1978.

Etheostoma tetrazonum (Hubbs
and Black)
Missouri saddled darter

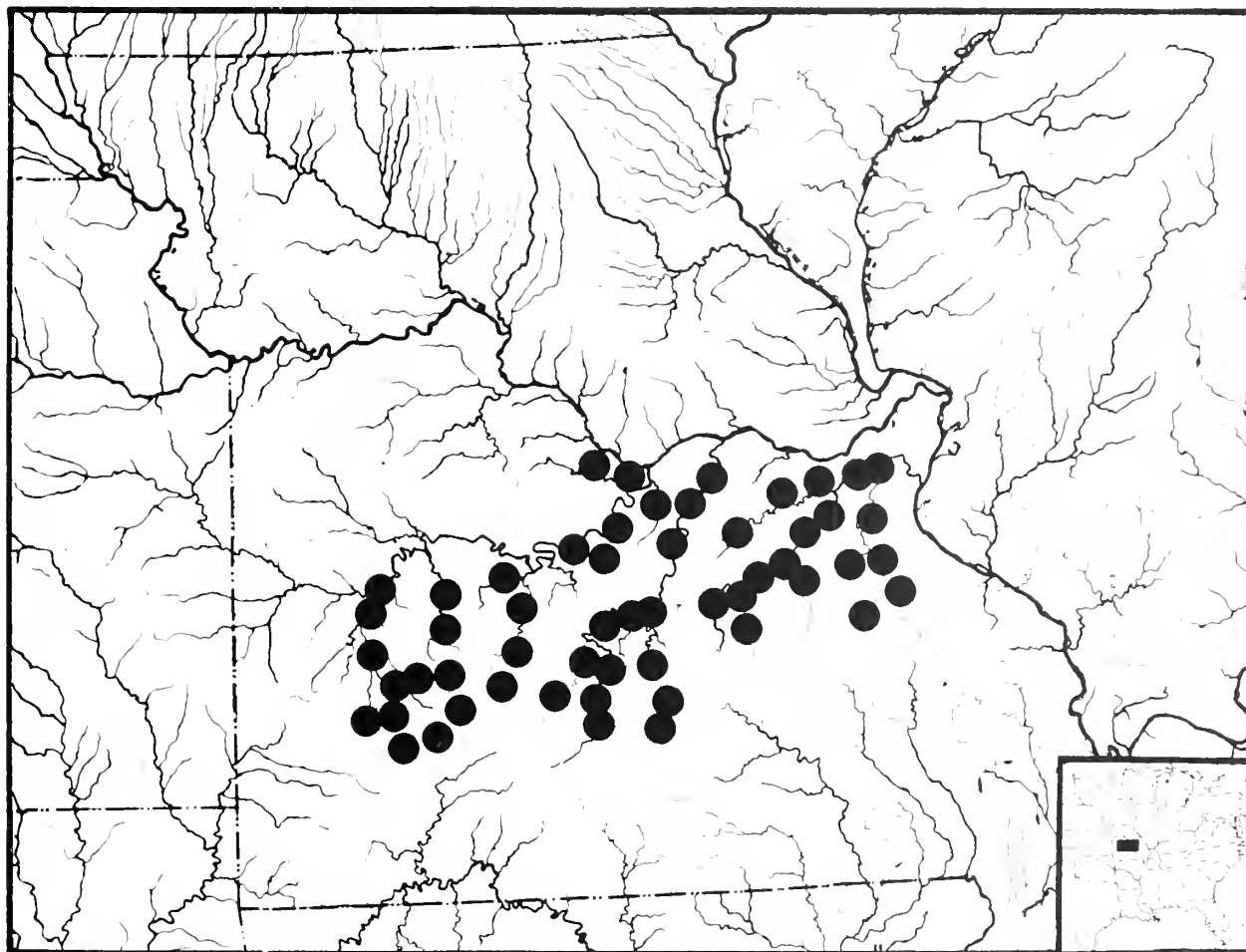
Order Perciformes
Family Percidae

TYPE LOCALITY: Big Niangua River at mouth of Greasy Creek, 9.6 km se of Buffalo, Dallas Co., MO (Hubbs and Black 1940. Occas. Pap. Mus. Zool. Univ. Mich. 416:1-30).

SYSTEMATICS: Subgenus *Etheostoma*. Member of *E. variatum* group. Replaces closely related *E. cazonum* in northern Ozarks (Missouri River drainage).



MO: Miller Co., Big Tavern Creek, 52 mm SL (Mo. Dept. Cons.)



DISTRIBUTION AND HABITAT: Endemic to MO, where restricted to streams of northern Ozarks from Moreau and Osage drainages east to Meramec drainage. Typically in high gradient, clear streams over coarse gravel and rock substrate. Often common in preferred habitat.

BIOLOGY: Spawns on riffles in late April and May (Pflieger 1975. *The Fishes of Missouri*). No other information available. Life history details probably similar in many ways to those of *E. variatum* (Trautman 1957. *The Fishes of Ohio*).

ADULT SIZE: 50-90 mm SL.

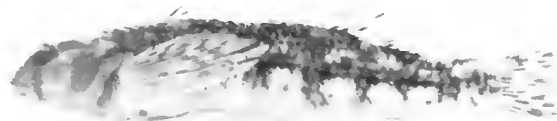
Compilers: J. R. Stauffer, Jr., C. H. Hocutt, and C. R. Gilbert. March 1978.

Etheostoma thalassinum (Jordan
and Brayton)
Seagreen darter

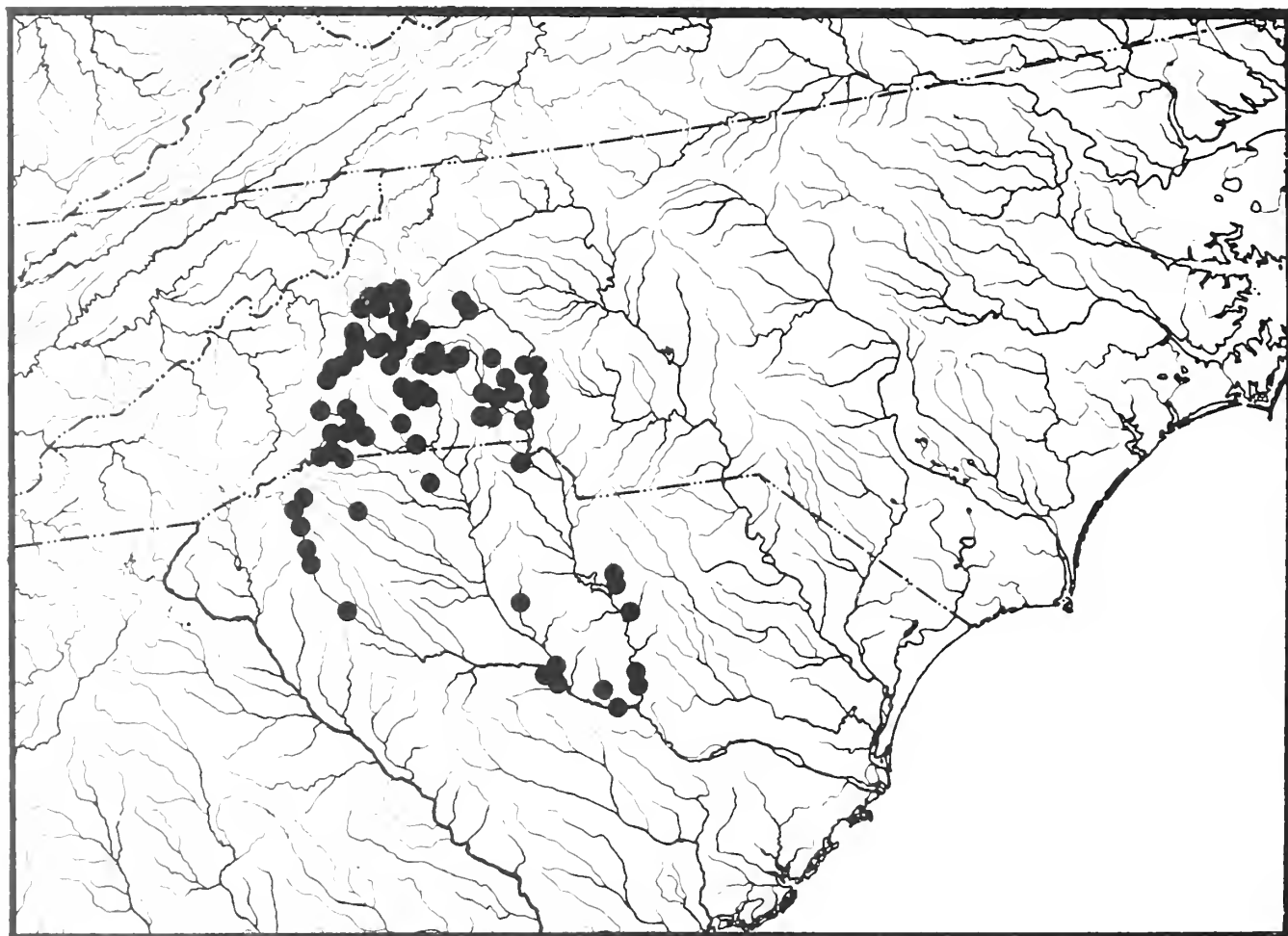
Order Perciformes
Family Percidae

TYPE LOCALITY: Saluda River near
Greenville, SC (Jordan and Brayton 1878.
U.S. Natl. Mus. Bull. 12:1-95).

SYSTEMATICS: Subgenus *Etheostoma*. Al-
lied to allopatric species *E. inscriptum* and
E. swannanoa, comprising *E. thalassinum*
species group (Richards 1966. Copeia:823-
38).



NC: Catawba Co., Jacobs Fork
Creek, 61 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Rubble-
bedrock or cobble riffles in higher gradient
tributaries of Santee drainage, NC and SC.
Most common in lower Blue Ridge-upper
Piedmont region and near Fall Line.

ADULT SIZE: 55-65 mm SL.

BIOLOGY: No published information.

Compiler: W. C. Starnes. May 1978.

Etheostoma tippecanoe Jordan and
Evermann
Tippecanoe darter

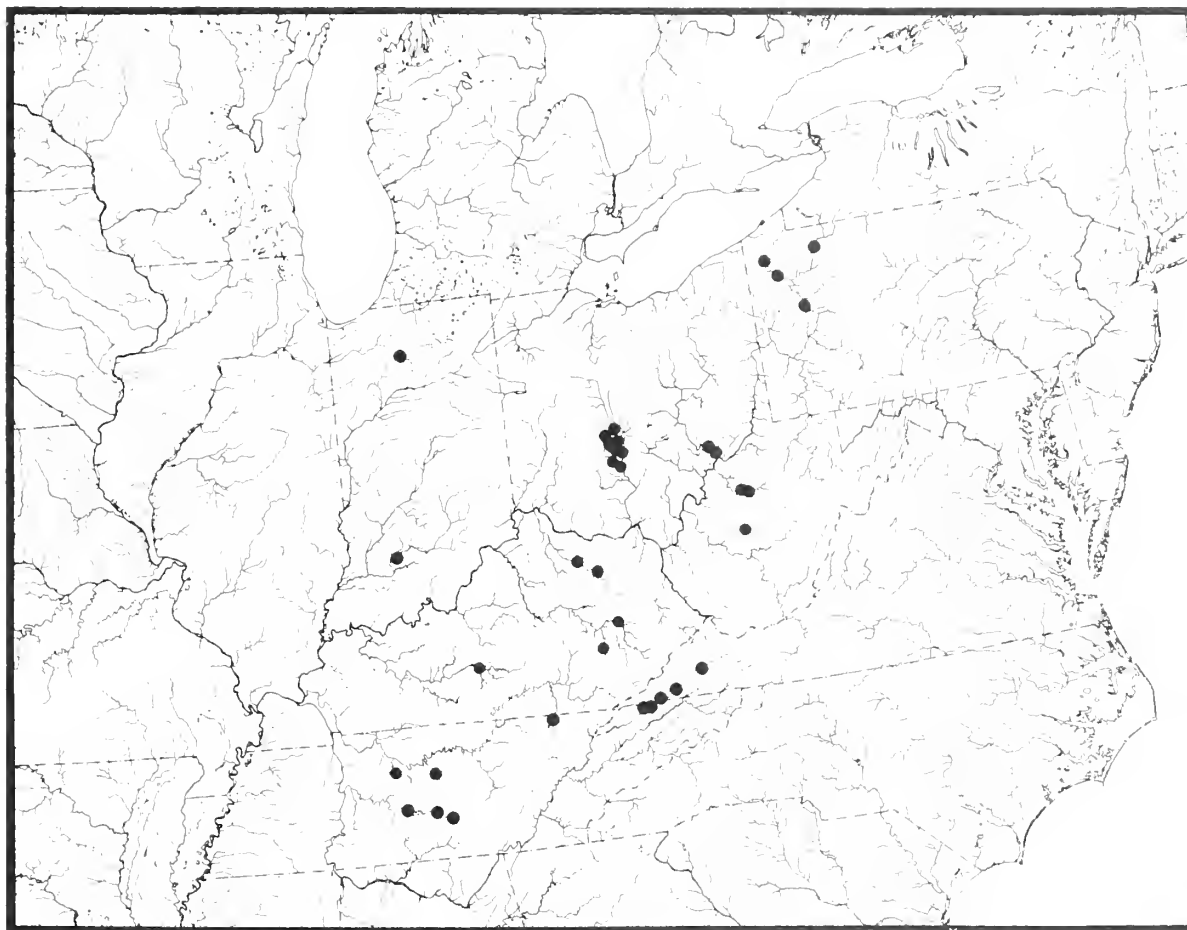
Order Perciformes
Family Percidae

TYPE LOCALITY: Tippecanoe River at Marshland, IN (Jordan and Evermann 1980, Proc. U.S. Natl. Mus. 13:3-4).

SYSTEMATICS: Subgenus *Nothonotus*. Apparently diverged early and relationships with other *Nothonotus* species unclear (Zorach 1972, Copeia:427-47). Systematics reviewed by Zorach (1969, Am. Midl. Nat. 81:412-34), who found Clinch system population to be distinctive but unnamed.



OH: Pickaway Co., Big Darby Creek, 30 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Widely and disjunctly distributed in Ohio basin: Alleghany drainage, PA; Mustungum and Scioto drainages, OH; Little Kanawha and Elk rivers, WV; Wabash drainage, IN; middle Licking River, upper Kentucky drainage, and Upper Green River, KY; Cumberland drainage, TN; Duck and Clinch rivers, Tennessee drainage, TN and VA. Occupies medium to large, warm, relatively unsilted streams. In KY and OH, apparently prefers long riffles, slow to moderate current, clean sand, gravel, and rubble bottom (Trautman 1957, *The Fishes of Ohio*;

Clay 1975, *The Fishes of Kentucky*). In TN and VA, virtually restricted to riffles and runs largely of "pea" gravel.

ADULT SIZE: 35 mm SL maximum.

BIOLOGY: Spawning males territorial, guarding eggs usually laid in 8 to 46 cm of water at heads or tails of riffles. Trautman (1957) reported that in turbid runoff species abandoned territories more readily than other darters associated with more rapid flow and less siltation.

Compiler: C. H. Hocutt, July 1979.

Etheostoma trisella Bailey and
Richards
Trispot darter

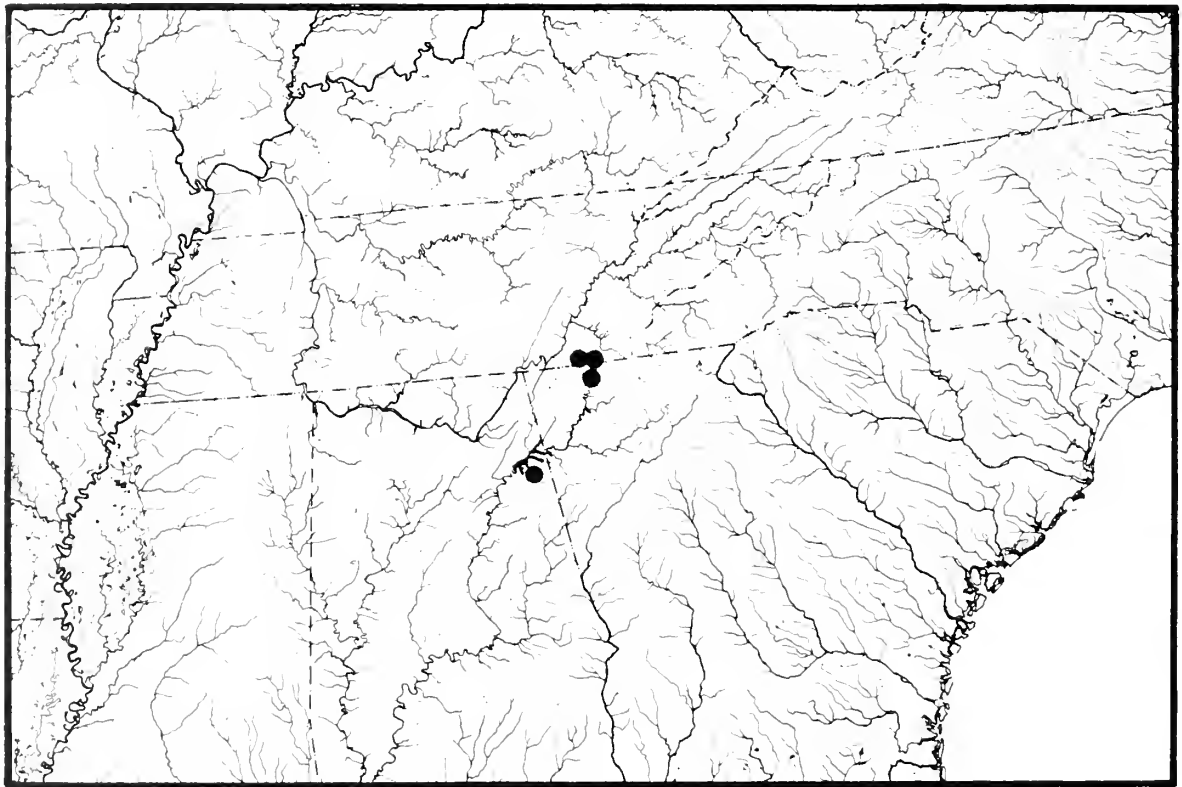
Order Perciformes
Family Percidae

TYPE LOCALITY: Cowans Creek, Cherokee Co., AL (Bailey and Richards 1963. Occas. Pap. Mus. Zool. Univ. Mich. 630:1-21).

SYSTEMATICS: Subgenus *Psychromaster*. Most closely related to *E. tuscumbia* (Bailey and Richards 1963).



GA: Whitfield Co., Coosa River system, male, 38 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Rare inhabitant of small, low gradient streams of upper Coosa River system, Mobile drainage, in AL, GA, and southeastern TN (Etnier 1970. Copeia:356-58).

BIOLOGY: Little known. Etnier (1970) captured a gravid female, in April, apparently about to spawn. Spawns in very shallow, overflow water alongside or away from main stream.

ADULT SIZE: 32-40 mm SL.

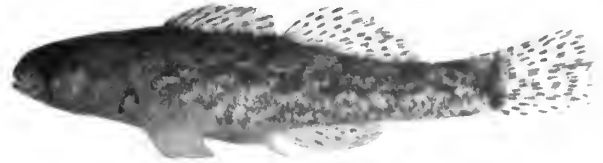
Compiler: S. T. Kucas. July 1978.

Etheostoma tuscumbia
Gilbert and Swain
Tuscumbia darter

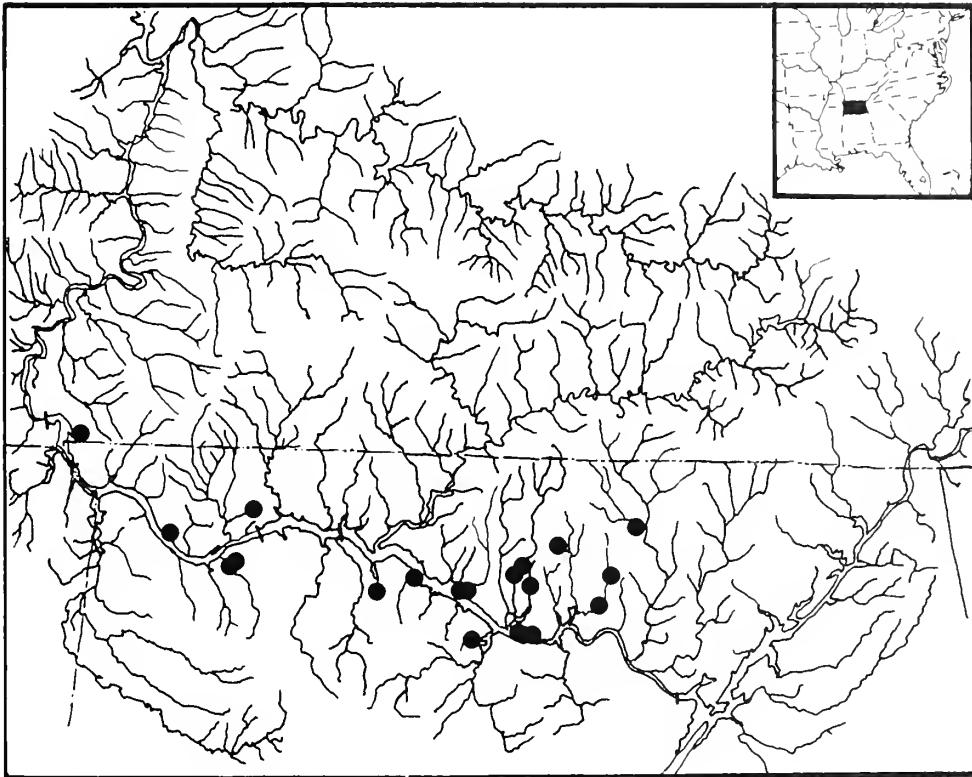
Order Perciformes
Family Percidae

TYPE LOCALITY: Tuscumbia Spring run at Tuscumbia, Colbert Co., AL (Gilbert and Swain 1887. Proc. U.S. Natl. Mus. 10:47-64).

SYSTEMATICS: Subgenus *Psychromaster*, originally the monotypic subgenus for *E. tuscumbia*, revised to include *E. trisella* (Bailey and Richards 1963. Occas. Pap. Mus. Zool. Univ. Mich. 630:1-21).



AL: Limestone Co., Tennessee
River drainage, female, 39 mm
SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Restricted to southern bend of Tennessee drainage in AL and TN, where it inhabits springs and spring runs usually with heavy growths of aquatic vegetation. Often common in preferred habitat. Highly localized. Extirpated in TN (Ramsey 1976. Bull. Ala. Mus. Nat. Hist. 2:53-65).

ADULT SIZE: 35-45 mm SL.

BIOLOGY: Considered an opportunistic forager (Koch 1978. ASB Bull. 25:56). Life cycle presumably short (Ramsey 1976).

Compiler: C. F. Saylor. May 1978.

Etheostoma variatum Kirtland
Variegate darter

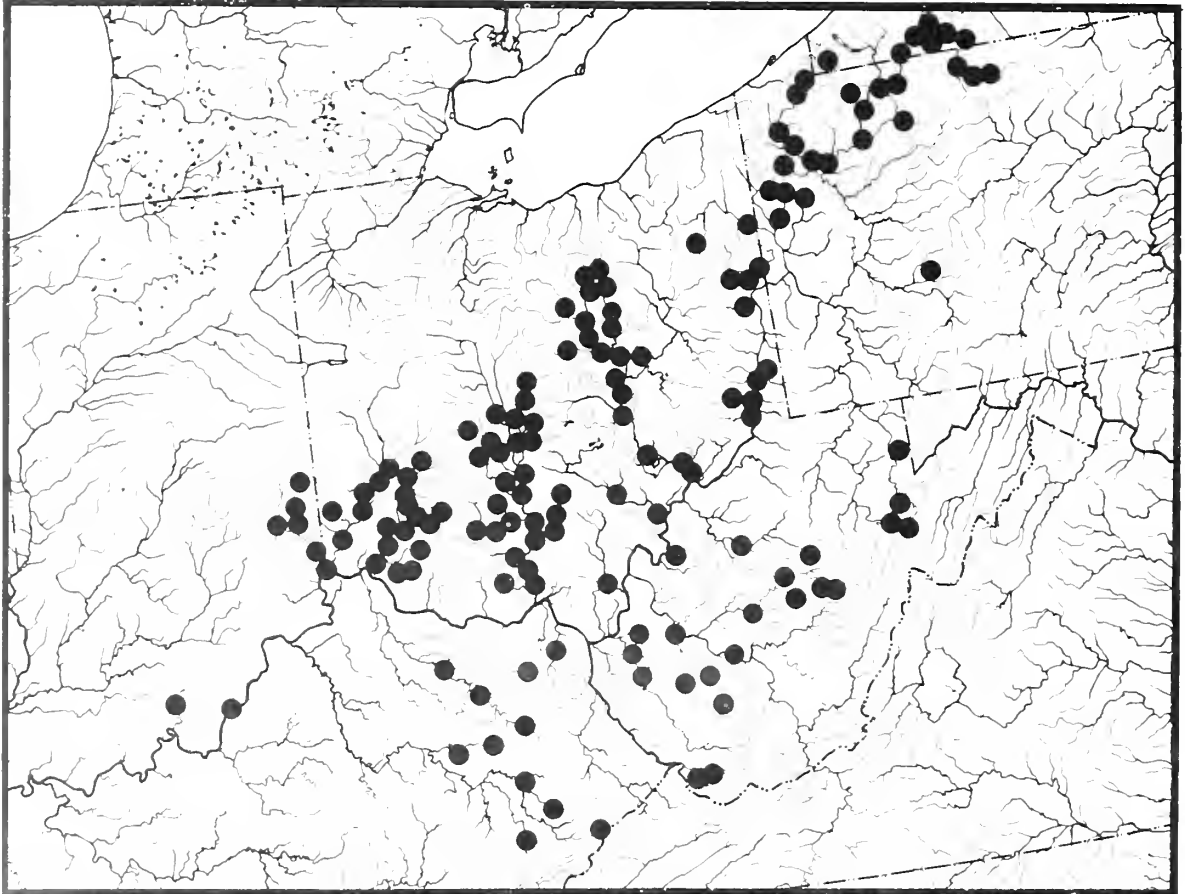
Order Perciformes
Family Percidae

TYPE LOCALITY: Mahoning River, tributary of Big Bear and Ohio rivers (presumably at Loveland's Ripple, near Youngstown), OH (Kirtland 1841. Boston J. Nat. Hist. 3: 273-79).

SYSTEMATICS: Subgenus *Etheostoma*. Forms closely related species group with the Ozarkian endemics *E. cazonum* and *E. tetrazonum*, and with the upper Kanawha River system endemics *E. osburni* and *E. kanawhae*. Hubbs and Black (1940. Occas. Pap. Mus. Zool. Univ. Mich. 416:1-30) reviewed systematics of group.



KY: Clay Co., Redbird Creek,
65 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Confined to Ohio River drainage (excluding upper Kanawha River system of WV, VA, and NC) from southcentral IN upstream to headwaters of Allegheny River system (NY and PA) and Monongahela system (PA and WV). Typically in rubble and small boulder riffles of moderate to large streams with rapid current, where riffles are from 7.6-22.9 m wide and 0.3-1.5 m deep (Trautman 1957, *The Fishes of Ohio*). Usually fairly common, but has disappeared in areas of heavy domestic, industrial or agricultural pollution.

ADULT SIZE: 73 mm SL maximum.

BIOLOGY: Food largely immature benthic insects (Turner 1922. Ohio J. Sci. 22:41-62). Trautman (1957) noted that most large individuals move downstream in late summer and fall, and winter in deeper riffles with slower current. Some adults winter in pools. Spawns in riffles mainly during mid-April to mid-May, water temperatures between 10 and 21°C in OH (May 1969. Ohio J. Sci. 69:85-92). Males grow faster than females; both sexes mature and spawn at age II; maximum life span four years (Lachner et al. 1950. Am. Midl. Nat. 43: 92-111). Reproductive behavior and larval development described by May (1969). Compiler: C. R. Gilbert, August 1979.

Etheostoma virgatum (Jordan)
Striped darter

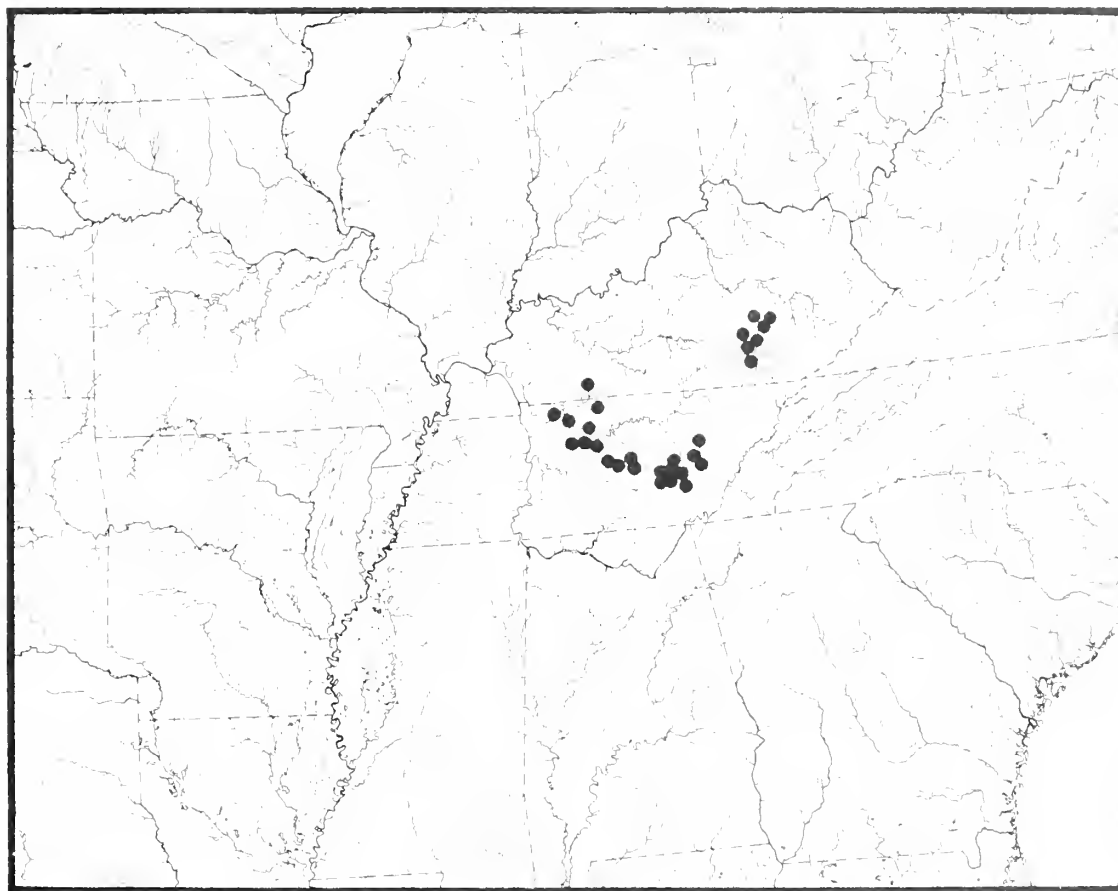
Order Perciformes
Family Percidae

TYPE LOCALITY: Rockcastle River, Livingston, Rockcastle Co., KY (Jordan 1880. Proc. U.S. Natl. Mus. 2:235-41).

SYSTEMATICS: Subgenus *Catonotus*. Closest relatives are other barcheek darters: *E. barbouri*, *E. obcyane*, *E. smithi*, and *E. striatulum* (Page 1975. Copeia:782-84; Page and Braasch 1977. Occas. Pap. Mus. Nat. Hist. Univ. Kans. 63:1-18). Geographic variation discussed by Page and Braasch (1977).



KY: Rock Castle River, Livingston, ca. 45 mm SL (Jordan and Evermann 1900).



Map modified from Page and Braasch 1977

DISTRIBUTION AND HABITAT: Endemic to, but absent throughout most of, Cumberland River drainage, KY and TN. Present and common in three portions of Cumberland: Rockcastle River and nearby streams, upper Caney Fork, and tributaries from Red River to Stones River. Occupies slab-rock pools of small to large streams.

ADULT SIZE: 30-65 mm SL.

BIOLOGY: Page and Schemske (1978. Copeia:406-12) examined competition with other *Catonotus*.

Compiler: L. M. Page, December 1978.

Etheostoma vitreum (Cope)
Glassy darter

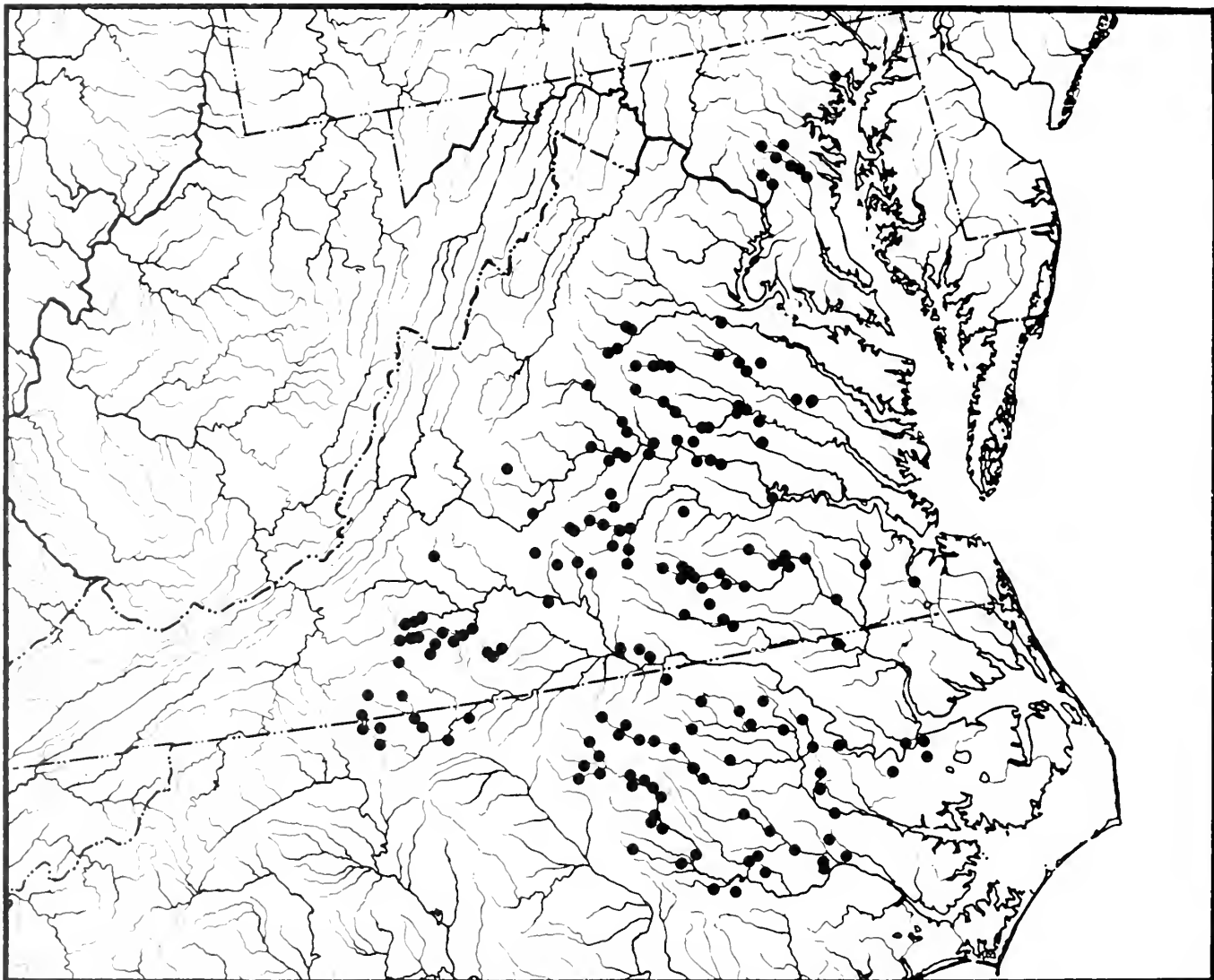
Order Perciformes
Family Percidae

TYPE LOCALITY: Walnut Creek, tributary of Neuse River, Wake Co., NC (Cope 1870. Proc. Am. Philos. Soc. 11:261-70).

SYSTEMATICS: Placed in monotypic subgenus *Ioa*. Bears superficial resemblance to species of *Ammocrypta* but this is believed to result from evolutionary convergence because of similar habitat preference.



MD: Prince Georges Co.,
Anacostia River,
53 mm SL. (NCSM)



DISTRIBUTION AND HABITAT: Occurs primarily in small to medium-sized sand and gravel-bottomed streams of Piedmont and upper Coastal Plain, from Neuse River drainage, NC, north to Patuxent drainage, MD. A record from Winters Run, Harford Co., MD, represents the northern range limit.

BIOLOGY: Spends much of the time partly buried in sand. Winn and Picciolo (1960. Copeia:186-92) studied the reproductive habits of a population near Washington, D.C. Kennedy (1965. Chesapeake Biol. Lab. [Mimeo]) and Rohde (1974. in Lippson and Moran Manual for Identification of Early Developmental Stages of Fishes of the Potomac River Estuary) described and illustrated some of the early developmental stages.

ADULT SIZE: 39-55 mm SL.

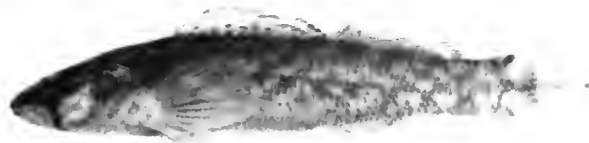
Compilers: D. S. Lee, R. E. Jenkins, C. R. Gilbert. March 1978.

Etheostoma whipplei (Girard)
Redfin darter

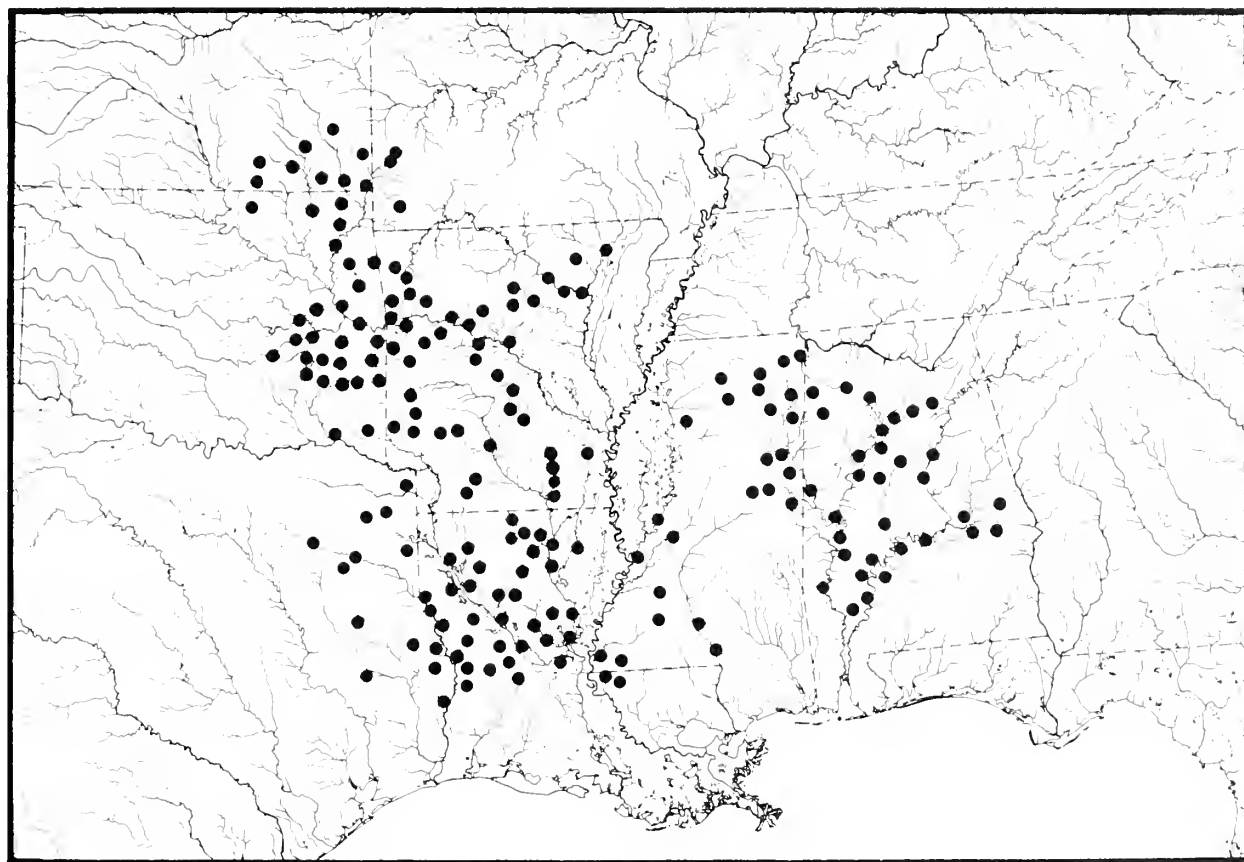
Order Perciformes
Family Percidae

TYPE LOCALITY: Coal Creek, AR (Girard 1860. Proc. Acad. Nat. Sci. Phila [1859] 11: 100-04).

SYSTEMATICS: Subgenus *Oligocephalus*. Hubbs and Black (1941. Occas. Pap. Mus. Zool. Univ. Mich. 429:1-27) recognized three subspecies: *E. w. whipplei*, *E. w. montanus*, and *E. w. artesiaae*. The last has also been considered a valid species and is in need of further study.



AL: Tuscaloosa Co., Black Warrior River system, male, 51 mm SL (Smith-Vaniz 1968).



Map modified from Hubbs and Black 1941

DISTRIBUTION AND HABITAT: Western part of lower Mississippi basin, from middle White system and middle and lower Arkansas drainage, south through MO, KS, OK, AR, and LA. Gulf of Mexico slope drainages from eastern TX (Sabine Lakes drainage) to Mobile drainage, AL.

ADULT SIZE: 46-64 mm TL, ca. 95 mm TL maximum.

BIOLOGY: No studies published. Known to spawn in early spring and feed on macroinvertebrates (Cross 1967. *Handbook of Fishes of Kansas*).

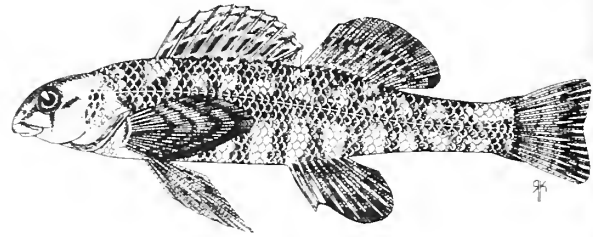
Compiler: S. P. Platania. June 1978.

***Etheostoma zonale* (Cope)**
Banded darter

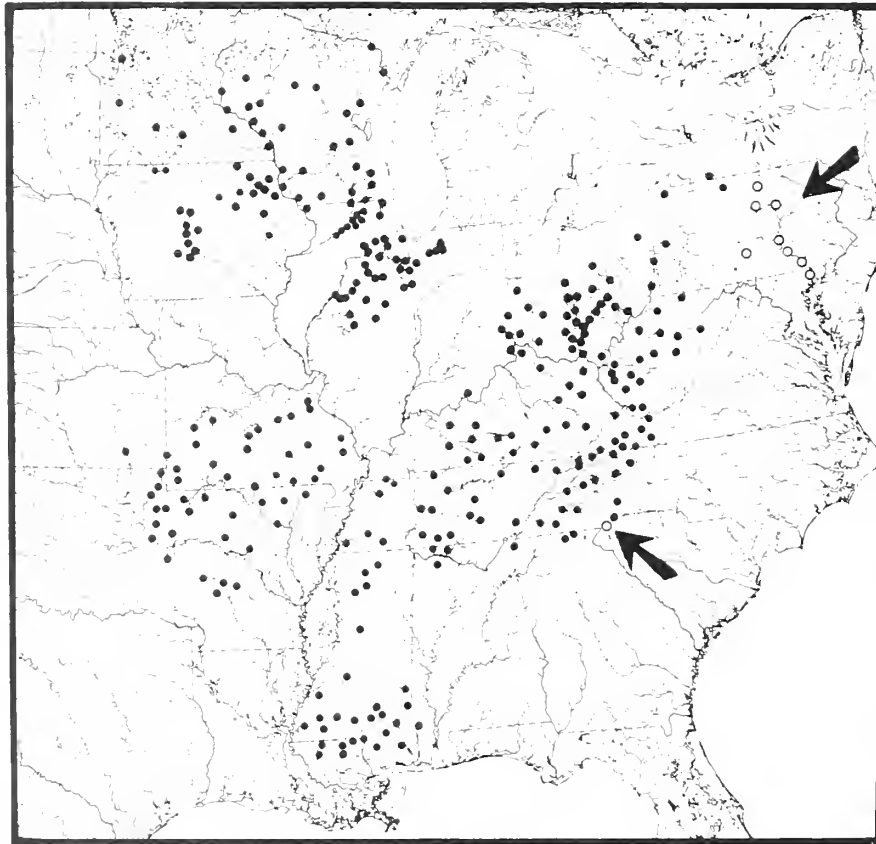
Order Perciformes
 Family Percidae

TYPE LOCALITY: North Fork Holston River, VA (Cope 1868. J. Acad. Nat. Sci. Phila. [Ser. 2] 6:207-47).

SYSTEMATICS: Subgenus *Etheostoma*. Lectotype designated by Tsai (in Collette and Knapp 1967. Proc. U.S. Natl. Mus. 119: 1-88). Tsai and Raney (1974. Copeia:1-24) recognized two subspecies and numerous races. Closest relatives, based principally on tuberculation, are *E. histrio* and *E. rupestre* (Collette 1965. Proc. U.S. Natl. Mus. 117: 567-614). Erickson (1977. Ph.D. diss., Univ. Minnesota) examined meristic characters in MN. Electrophoretic studies done by Page and Whitt (1973. Comp. Biochem. Physiol. 44B:611-23).



MD: Conowingo Dam Fish
 Collection Facility, 39 mm SL
 (NCSM).



Open circles transplanted populations

DISTRIBUTION AND HABITAT: *Etheostoma z. zonale* widely distributed and usually common in Mississippi basin from KS and TN north to MN and NY. Reportedly introduced to Savannah River, NC and SC (Tsai and Raney 1974), and Susquehanna River, PA (Denoncourt et al. 1975. Proc. Pa. Acad. Sci. 49:45-46). *Etheostoma z. lynceum* occurs on Coastal Plain of Lower Mississippi Valley, TN to LA, and central Gulf Coast of eastern Mississippi River, MS and LA, to extreme southwestern AL. Normally found among gravel, rubble, and boulders of riffles with moderate to swift current in small to medium-sized rivers, and shore-zone riffles of large rivers.

ADULT SIZE: 45-62 mm SL.

BIOLOGY: Life history and parasites in Cannon River, MN summarized by Erickson (1977). Sexually dimorphic in color and size (males brighter and larger). Spawns June through July in MN.

Compiler: R. F. Denoncourt. January 1979.

Etheostoma zoniferum (Hubbs
and Cannon)
Backwater darter

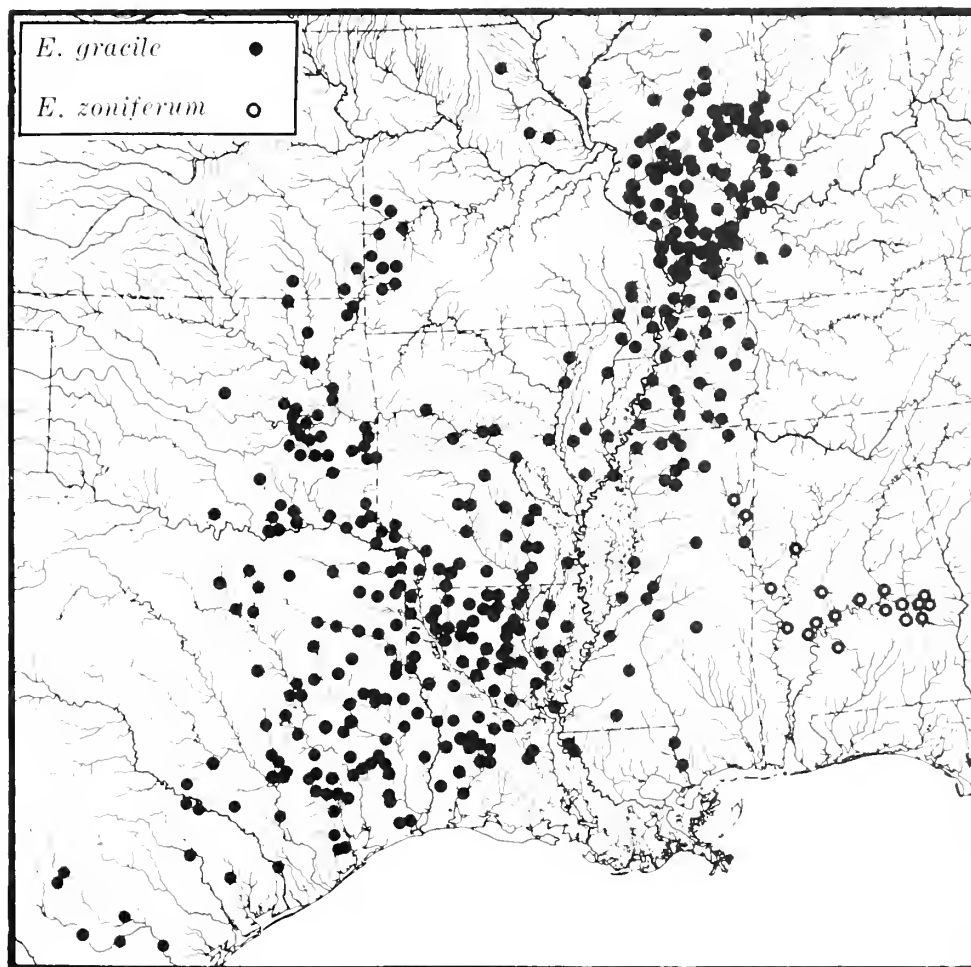
Order Perciformes
Family Percidae

TYPE LOCALITY: Catoma Creek, 8 km sw of Montgomery, Montgomery Co., AL (Hubbs and Cannon 1935. Misc. Publ. Mus. Zool. Univ. Mich. 30:1-93).

SYSTEMATICS: Subgenus *Hololepis*. Collette (1962. Tulane Stud. Zool. 9:115-211) reviewed species. Closest relative is *E. gracile*.



AL: Macon Co., Tallapoosa River system, male, 32 mm SL (Smith-Vaniz 1968).



Map modified from Collette 1962

DISTRIBUTION AND HABITAT: Alabama and Tombigbee systems of Mobile Bay drainage, below Fall Line, in AL and MS (Collette 1962). Inhabits pools with mud or gravel substrate (Hubbs and Cannon 1935).

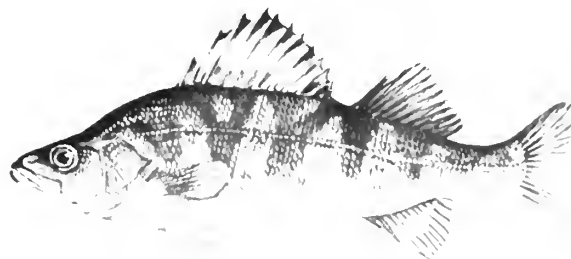
BIOLOGY: Collette (1962) reported on sexual dimorphism.

ADULT SIZE: 25-35 mm SL.

Compiler: C. H. Hocutt. September 1978.

Perca flavescens (Mitchill)
Yellow perch

Order Perciformes
Family Percidae



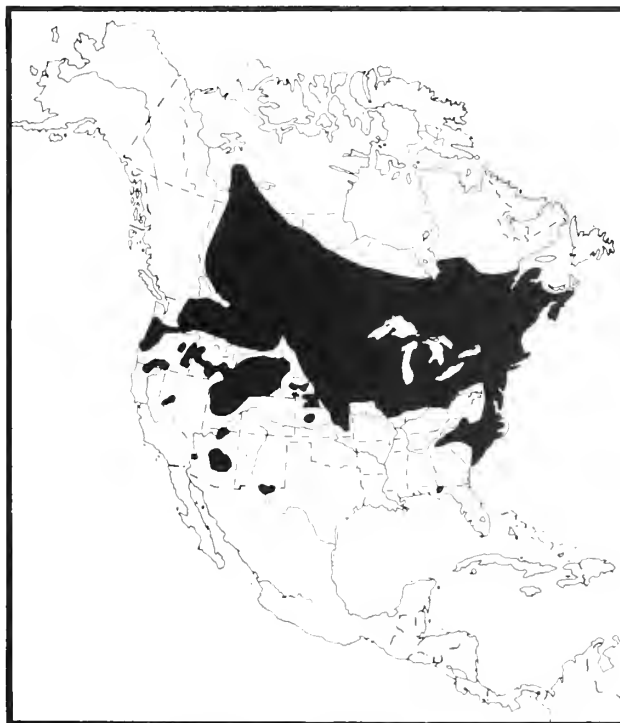
(N.C. Wildl. Resour. Comm.
and NCSM)

TYPE LOCALITY: New York (Mitchill 1814. Rept. on Fishes of New York:1-30).

SYSTEMATICS: Subfamily Percinae, tribe Percini. Collette (1963. Copeia: 615-23) and Collette and Banareseu (1977. J. Fish. Res. Board Can. 34:1450-63) discussed systematic relationships of genus. Svetovidov and Dorofeeva (1963. Vopr. Ikhtiol. 3:625-51) recognized single circumpolar species, *P. fluvialis*. This has been questioned by some North American taxonomists. Bailey et al. (1970. Am. Fish. Soc. Spec. Publ. 6:1-150) considered data inconclusive and retained name *P. flavescens* for North American populations. Scott and Crossman (1973. *Freshwater Fishes of Canada*) provided brief summary of meristic studies and nomenclature.



Former Distribution



Present Distribution

See map on next page

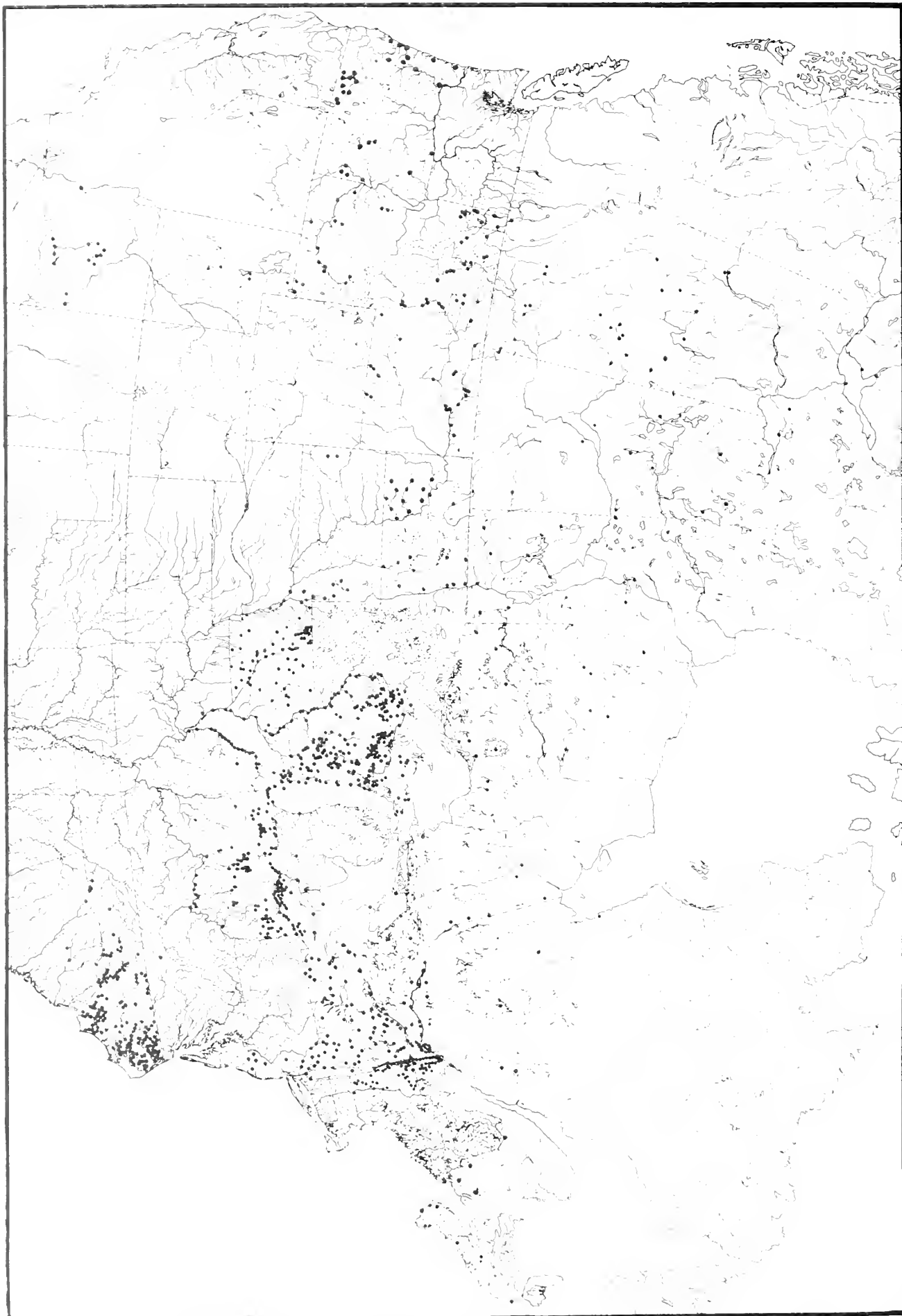
DISTRIBUTION AND HABITAT: Fresh and (rarely) brackish waters, from NS to Santee River drainage, SC. West of Appalachians from PA to upper MO, and from eastern KS northwest to MT; north to Great Slave Lake and south and east to James Bay, QU and NK. Introduced to nearly all states west and south of former range. Very adaptable species that lives in variety of habitats. Most common in clear, open water with moderate vegetation. Occurs irregularly at depths greater than 10 m.

ADULT SIZE: 152-305 mm TL.

BIOLOGY: Because of value as commercial and recreational fish, extensive literature available on age, growth, reproduction, and other life history aspects. Scott and Crossman (1973) provided excellent summary of most aspects of biology, and Collette et al. (1977. J. Fish. Res. Board Can. 34:1890-99) gave a broad overview of biology of this and other percid genera.

Compiler: D. S. Lee. February 1978.

Distribution of yellow perch, *Perca flavescens*

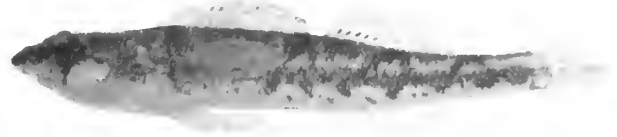


Percina antesella Williams and Etnier
Amber darter

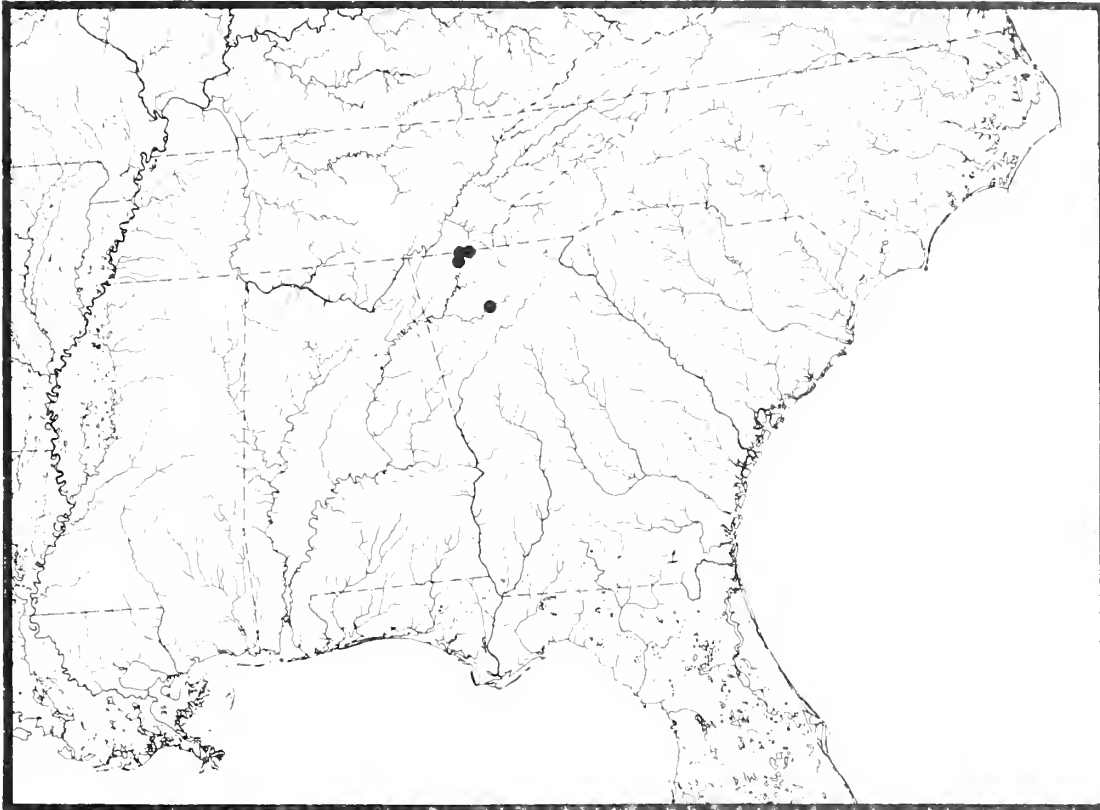
Order Perciformes
Family Percidae

TYPE LOCALITY: Conasauga River at state hwy. 74 bridge, Bradley Co., TN (Williams and Etnier 1977. Proc. Biol. Soc. Wash. 90:6-18).

SYSTEMATICS: Subgenus *Imostoma*. Appears to form distinct phyletic line along with *P. ouachitae*, *P. tanasi*, and *P. uranidea*, members of "saddleback" species group.



GA: Murray-Whitfield cos.,
Conasauga River, 46 mm SL (J.
L. Harris).



DISTRIBUTION AND HABITAT: Known only from Conasauga and Etowah rivers in northwestern GA and extreme southeastern TN, headwater tributaries of Coosa River. Extirpated from Shoal Creek, Cherokee Co., GA, the only Etowah River locality, due to impoundments and agricultural runoff. Most frequently found in riffles of cool, clear water up to 0.6 m deep, with moderate to swift current and substrate of cobbles and silt-free sand. Never very common, but a few individuals almost always observed at type locality.

ADULT SIZE: 45-60 mm SL.

BIOLOGY: No data available. Appears especially vulnerable to impoundment and siltation of habitat.

Compiler: S. P. Platania, February 1978.

Percina aurantiaca (Cope)
Tangerine darter

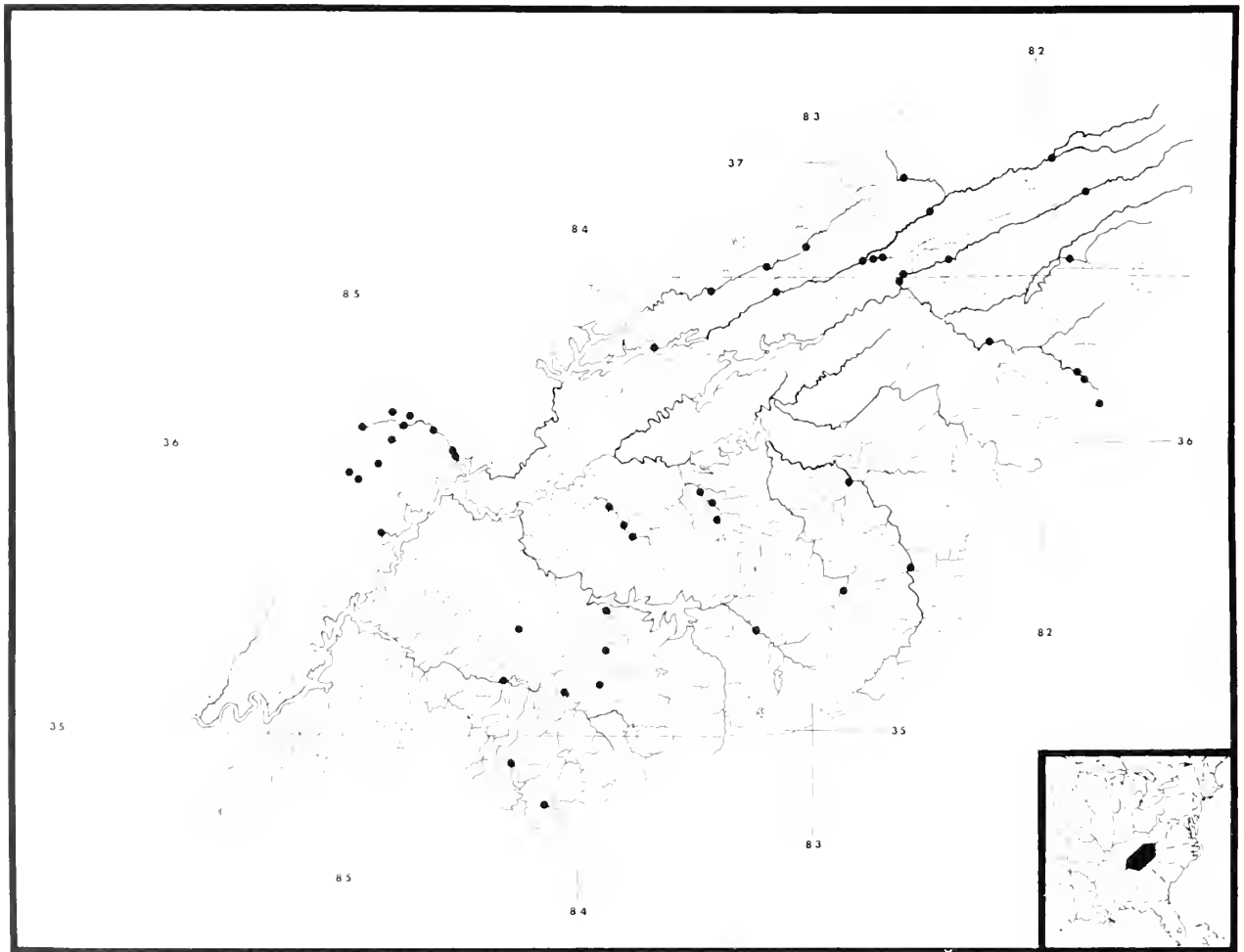
Order Perciformes
Family Percidae

TYPE LOCALITY: North Fork Holston River (probably at Saltville), VA (Cope 1868, J. Acad. Nat. Sci. Phila. [Ser. 2.], 6:207-47).

SYSTEMATICS: Only member of subgenus *Hypohomus* (Thompson 1972, Abstr. 52 Annu. ASIH meetings; Page 1974, Copeia: 66-86); not closely related to other subgenera of *Percina*.



VA: Scott Co., Copper Creek, male, 126 mm SL (B. A. Thompson).



DISTRIBUTION AND HABITAT: Upper Tennessee River in GA, NC, VA, and TN. Adults most often taken from deep, swiftly-flowing runs and rapids near boulders. Juveniles and young found in shallower, quieter waters, sometimes pools. Populations disjunct, usually relatively small.

ADULT SIZE: 95-149 mm SL.

BIOLOGY: Little known. Howell (1971, Ph.D. diss., Univ. Tennessee) observed spawning in artificial "raceway" and also discussed age and growth and food habits. Spawning in nature most likely during April and May, possibly into June; very small young-of-year taken early July (Thompson 1977, Ph.D. diss., Tulane Univ.).

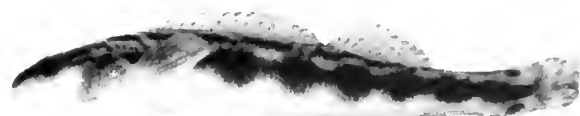
Compiler: B. A. Thompson, May 1979.

Percina aurolineata Suttkus and Ramsey
Goldline darter

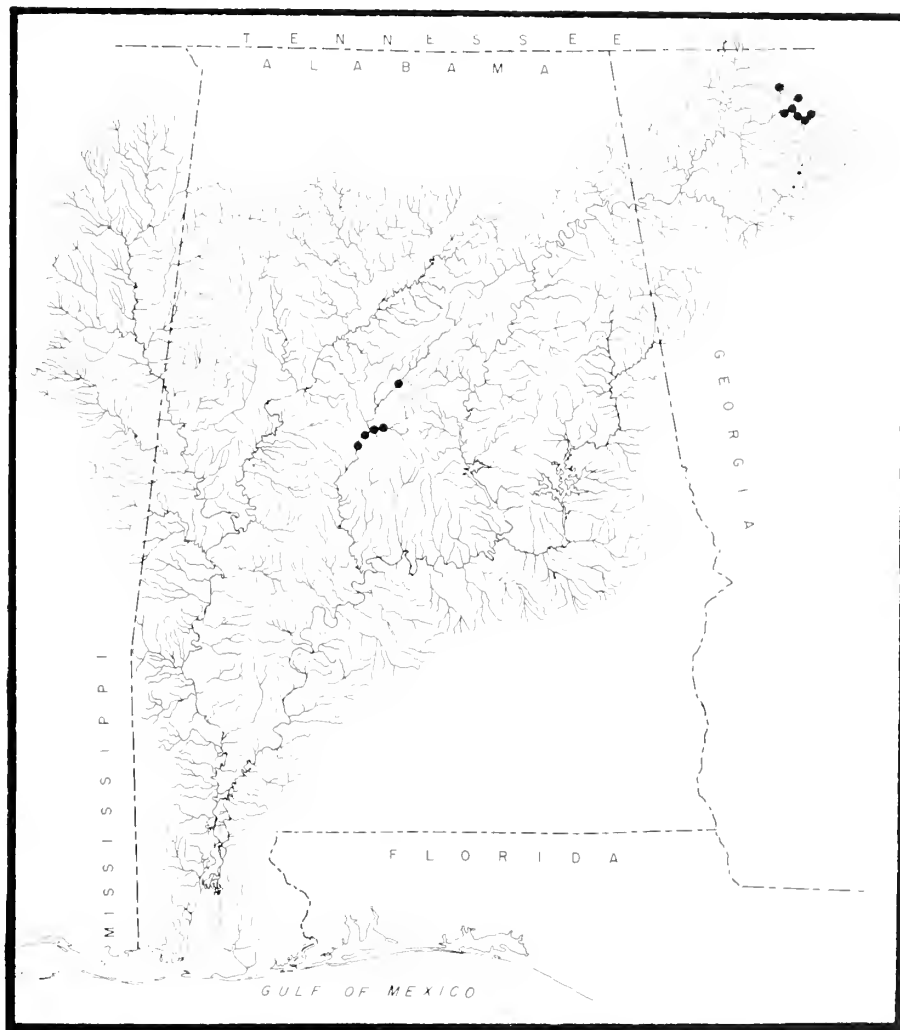
Order Perciformes
Family Percidae

TYPE LOCALITY: Coosawattee River, 183 m below mouth of a small spring tributary, 6.7 km sw of center of Ellijay, Gilmer Co., GA (Suttkus and Ramsey 1967, Tulane Stud. Zool. 13:129-45).

SYSTEMATICS: Subgenus *Hadropterus*. Closest relatives appear to be *P. lenticula*, *P. seiera*, and *P. nigrofasciata* (Suttkus and Ramsey 1967; Page 1974, Copeia:66-86).



AL: Bibb Co., Little Cahaba River, 59 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Known only from headwaters of Coosa River system (Coosawattee River) in Ellijay and Cartecay rivers, and Mountaintown Creek, all in Gilmer Co., GA, and in Cahaba and Little Cahaba rivers, Bibb and Shelby cos., AL (Bryant et al. 1979, Proc. Southeast. Fish. Coun. 2:1-4). Inhabits main channels of rivers in areas of white-water rapids to three or more feet deep, and substrates of bedrock, boulders, rubble, and gravel. *Podostemum* and *Justicia* are characteristic of habitat.

ADULT SIZE 42-74 mm SL.

BIOLOGY: Very little known. Three females (36 to 53 mm SL), collected 13 March in Cahaba River, contained no ripe eggs, but one female (57 mm) captured 8 April and another (49 mm) captured 7 June contained eggs apparently ready for spawning. Two males (51 and 58 mm) collected in Coosawattee on 9 September had completely regressed testes. Spawning probably occurs from early April to late June in Cahaba, and perhaps a few weeks later in Coosawattee. Guts of six specimens contained insect larvae, mostly chironomids.

Compiler: H. T. Boschung, July 1979.

Percina burtoni Fowler
Blotchside logperch

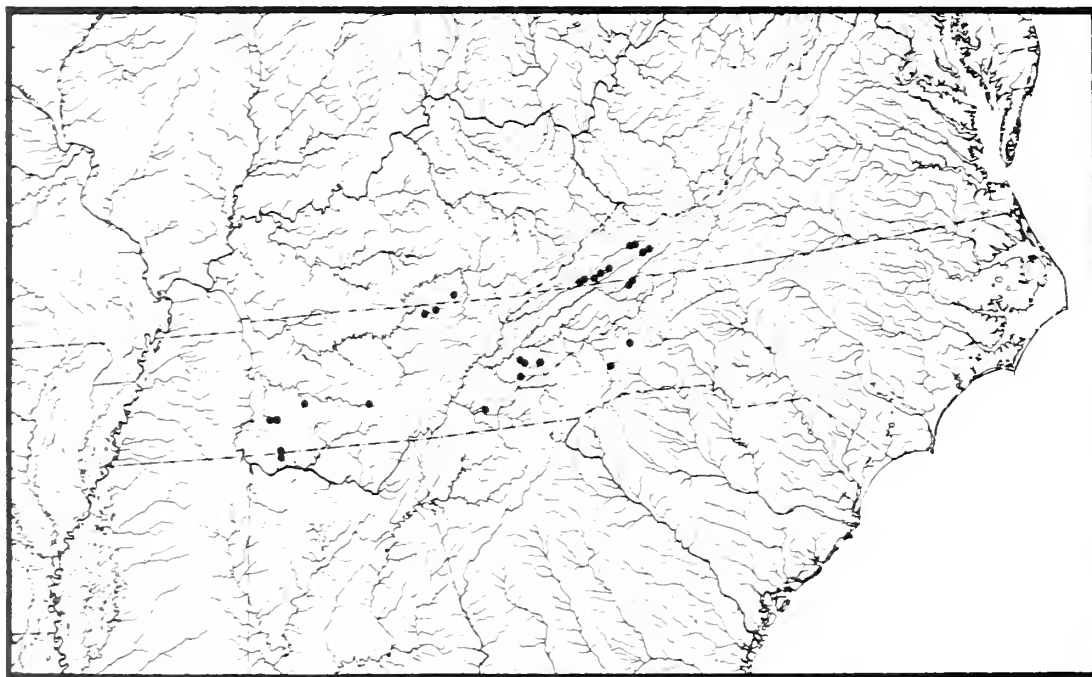
Order Perciformes
Family Percidae

TYPE LOCALITY: Swannanoa River near Oteen, Buncombe Co., NC (Fowler 1945. Acad. Nat. Sci. Phila. Monog. 7:1-408).

SYSTEMATICS: Subgenus *Percina*. Most closely related to *P. rex* and other members (Thompson 1978. ASB Bull. 25:57) of the subgenus with an orange band in the spinous dorsal fin that have long been confounded under the name *P. caprodes carbonaria*. Originally described as subspecies of *P. caprodes*. Elevated by Bailey et al. (1970. Am. Fish. Soc. Spec. Publ. 6:1-150) on our recommendation.



VA: Scott Co., Copper Creek,
male, 116 mm SL (R.E.
Jenkins).



DISTRIBUTION AND HABITAT: Widely but disjunctly distributed in mountains and uplands of Tennessee drainage, VA, NC, TN, and AL. Localized in uplands of middle Cumberland drainage, TN and KY. Some populations in both drainages apparently extirpated. Typically inhabits medium-sized, warm, usually clear streams of moderate gradient, where it occupies riffles, runs, and pools with gravel to boulder strewn bottoms lacking major siltation. Populations generally of low density.

ADULT SIZE: 90-130 mm SL.

BIOLOGY: Feeds mainly on benthic organisms; food often obtained after overturning stones with snout. Based on gonadal development, apparently spawns in spring.

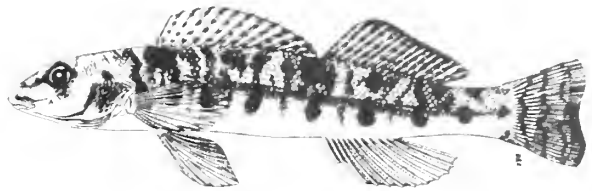
Compilers: R. E. Jenkins and T. Zorach.
July 1978.

Percina caprodes (Rafinesque)
Logperch

Order Perciformes
Family Percidae

TYPE LOCALITY: Ohio River (presumably in vicinity of Louisville, KY) (Rafinesque 1818. *Am. Month. Mag. Crit. Rev.* 3:354-56).

SYSTEMATICS: Subgenus *Percina*. Revision of subgenus, currently being done by several workers, will greatly alter present concept of this species. Hubbs and Lagler (1964. *Fishes of the Great Lakes*), Scott and Crossman (1973. *Freshwater Fishes of Canada*), and others recognized subspecies *P. c. semifasciata*, *P. c. caprodes*, and *P. c. carbonaria*, but Jenkins (1976. *Copeia*: 642-44) and Jenkins et al. (1977. *Abstr. 57 Annu. ASIH meetings*) elevated *carbonaria* to species status and presented other unresolved problems in the subgenus. Thompson (1978. *Abstr. 58 Annu. ASIH meetings*) considered logperches in southeastern United States to represent four undescribed species. Trautman (1957. *The Fishes of Ohio*), Gerking (1945. *Indiana Lakes Streams* 3:1-137) and Smith (1979. *The Fishes of Illinois*) discussed intergradation between *P. c. caprodes* and *P. c. semifasciata*.



MD: Cecil Co., above
Conowingo Creek, 84 mm SL
(NCSM).



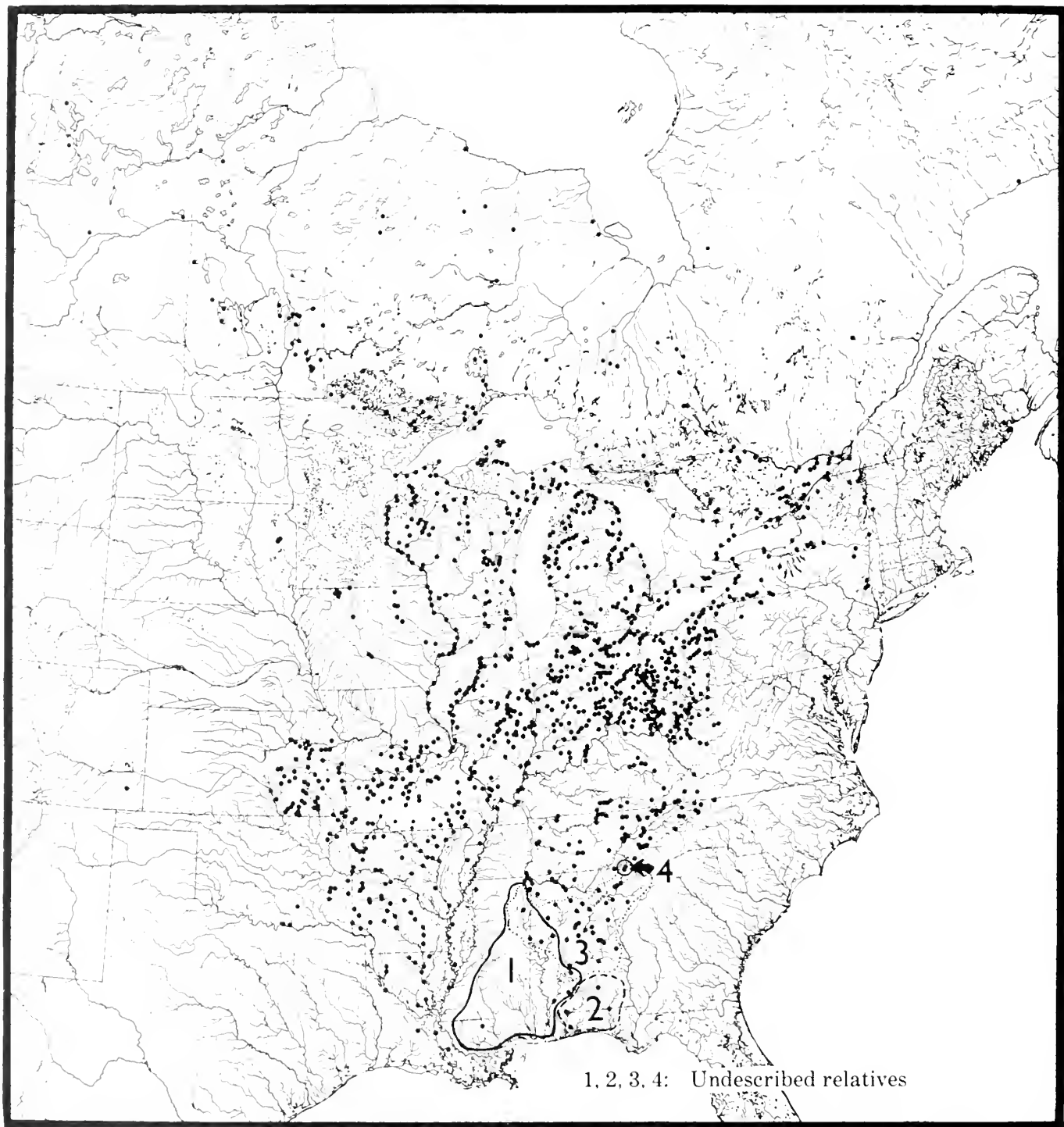
See map on next page

DISTRIBUTION AND HABITAT: Probably most widespread of all darters. *Percina c. caprodes* in Ohio basin, White system in Ozarks, Red system in Ouachitas, and Atchafalaya system; *P. c. semifasciata* in upper Mississippi, Great Lakes and Hudson Bay drainages, and along central Atlantic slope. Habitat preferences range from small creeks to rivers, lakes, and reservoirs. Overall, species prefers clean riffles and runs over mixed sand and gravel, avoiding silted areas.

ADULT SIZE: 100-150 mm SL.

BIOLOGY: Turner (1921. *Ohio J. Sci.* 22: 41-62) presented information on food habits. Winn (1958a. *Am. Midl. Nat.* 59:190-212; 1958b. *Ecol. Monogr.* 28:155-91) discussed aspects of reproductive behavior. Cross (1967. *Univ. Kans. Mus. Nat. Hist. Misc. Publ.* 45:1-357), Thomas (1970. *Ill. Nat. Hist. Surv. Biol. Notes* 70:1-18), Scott and Crossman (1973), Miller and Robison (1973. *Fishes of Oklahoma*), Eddy and Underhill (1974. *Northern Fishes*), Pflieger (1975. *The Fishes of Missouri*) and Smith (1979) reviewed aspects of biology, including food habits, spawning, and age and growth.

Compiler: B. A. Thompson. May 1979.



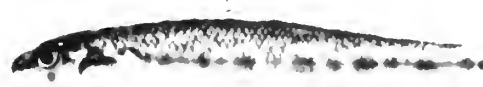
Distribution of logperch, *Percina caprodes*

Percina copelandi (Jordan)
Channel darter

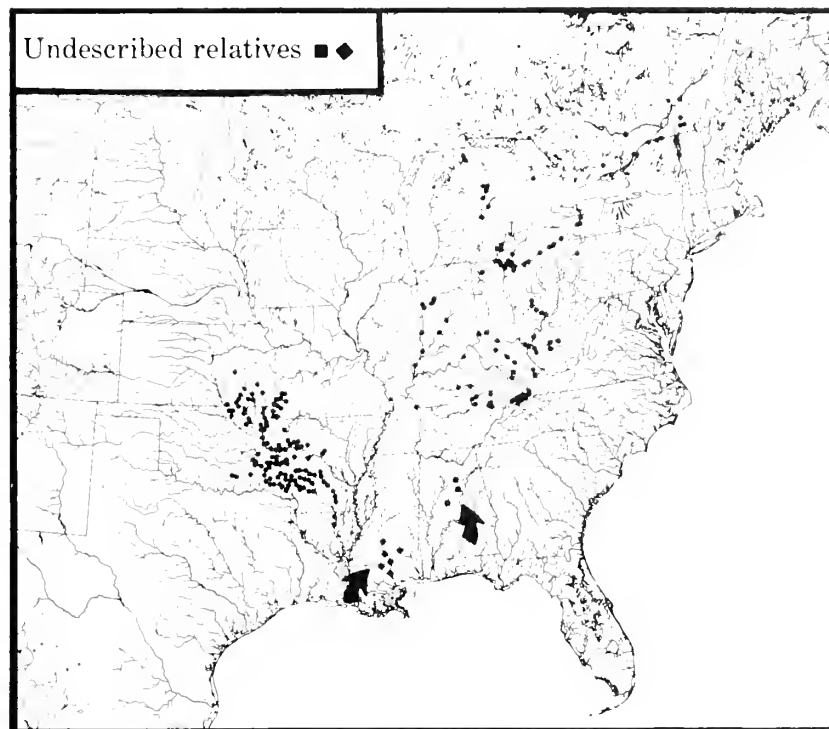
Order Perciformes
Family Percidae

TYPE LOCALITY: White River, 8 km n of Indianapolis, IN (Jordan 1877. U. S. Natl. Mus. Bull. 10: 1-68).

SYSTEMATICS: Subgenus *Cottogaster*. R. D. Suttkus, who is studying systematics, states (pers. comm.) that populations from eastern Gulf slope represent undescribed species.



MI: Iosco Co., AuSable River,
38 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Wide, disjunct distribution. Red and Arkansas river drainages in OK, AR, northern LA, south-eastern KS, and southwestern MO. East of Mississippi River occurred disjunctly in lower Tennessee River drainage, KY (population now apparently extirpated), and still lives in upper Tennessee drainage, TN and VA [see Starnes et al. (1977. Copeia: 783-86) for zoo-geographic explanation]. Ranges to northeast throughout most of Ohio River drainage and lower half of Great Lakes basin (lakes Michigan, Erie, and Ontario drainages). Disjunct population in lower St. Lawrence River drainage of southeastern ON, southwestern QU, NY, and VT. Closely related, undescribed species occur in Pearl and Pascagoula river drainages, MS (population now extremely rare and bordering on extinction) and in Mobile Bay basin, AL, respectively. Generally restricted to large rivers and their major tributaries, where occurs on sand-gravel shoals and riffles. Occasionally common, but often sporadically distributed.

ADULT SIZE: up to 61 mm TL

BIOLOGY: Scott and Crossman (1973. *Fresh-water Fishes of Canada*) summarized papers (dealing with northern populations) of Winn (1953. Copeia: 26-30) on breeding behavior and food habits, Turner (1921. Ohio J. Sci. 22: 41-62) on food habits, Bangham and Hunter (1939. Zoologica 24: 385-418) on parasites, and Fish (1932. Bull. U. S. Bur. Fish. 47: 293-398) on larval development. Branson (1967. Am. Midl. Nat. 78: 126-54) discussed seasonal patterns of occurrence in Neosho River system, OK. In MI, spawning occurs in July at water temperatures of approximately 21°C whereas in KS spawning takes place earlier (Cross 1967. *Fishes of Kansas*). Eggs deposited in gravel. In Lake Erie, both young and adults fed primarily on mayfly and midge larvae, and also ingested algae and bottom debris. In OK, found to overwinter in quiet, leaf- and debris-filled backwaters, moving back into main channel during April and May.

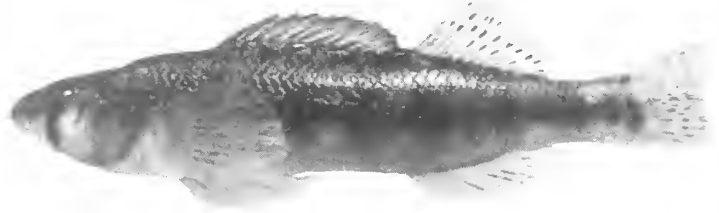
Compilers: C. R. Gilbert and G. H. Burgess.
May 1979.

Percina crassa (Jordan and
Brayton)
Piedmont darter

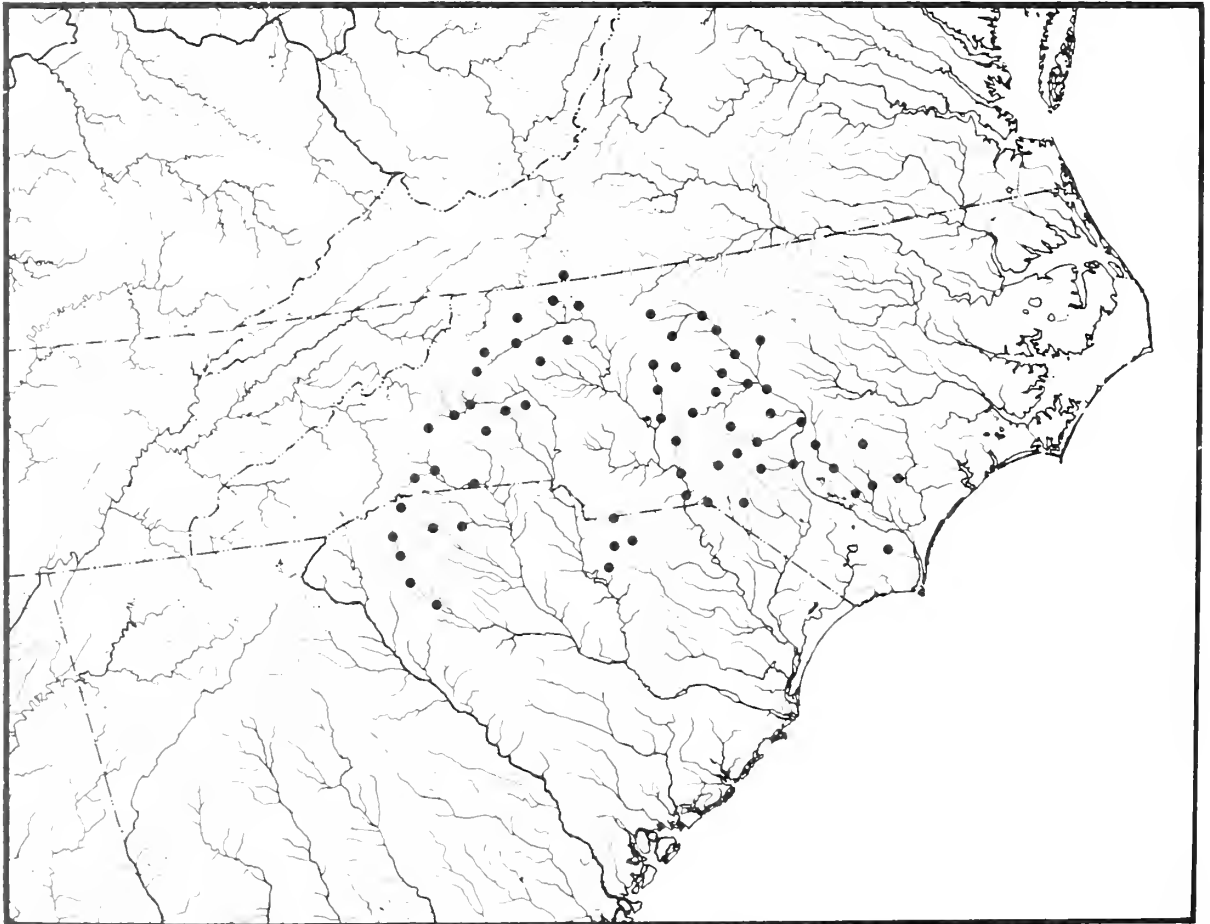
Order Perciformes
Family Percidae

TYPE LOCALITY: Saluda River (at Farr's Mills) near (west of) Greenville, (Greenville Co.,) SC (Jordan and Brayton 1878. U.S. Natl. Mus. Bull. 12:1-237), subsequently designated by Raney (in Collette and Knapp 1967. Proc. U.S. Natl. Museum 119:1-88).

SYSTEMATICS: Transferred from subgenus *Ericosma* to subgenus *Alvordius* by Page (1974. Copeia :66-86). Morphologically somewhat intermediate in some characters between *P. peltata* and *P. roanoka*; formerly considered conspecific with both. Elevated to specific status by Bailey and Gosline (1955. Misc. Publ. Mus. Zool. Univ. Mich. 93:1-44). Treated as species distinct from *P. roanoka* by Page (1974). A thorough systematic study by Mayden and Page (1979. Copeia : 413-26) indicated closer relationship between *P. crassa* and *P. peltata* than between *P. crassa* and *P. roanoka*.



NC: Guilford Co., Little Alamance Creek, male, 67 mm SL (INHS).



DISTRIBUTION AND HABITAT: Cape Fear, Peedee, and Santee river drainages, VA, NC, and SC. Common in Cape Fear River drainage. Found in Blue Ridge foothills, Piedmont and upper Coastal Plain; more common in former two. Inhabits riffles and fast raceways with gravel, rubble, and/or boulder substrates in medium to large streams and rivers.

ADULT SIZE: 50-65 mm SL, 75 SL maximum.

BIOLOGY: No information.

Compiler: R. L. Mayden. April 1978.

***Percina cymatotaenia* (Gilbert and Meek)**
Bluestripe darter

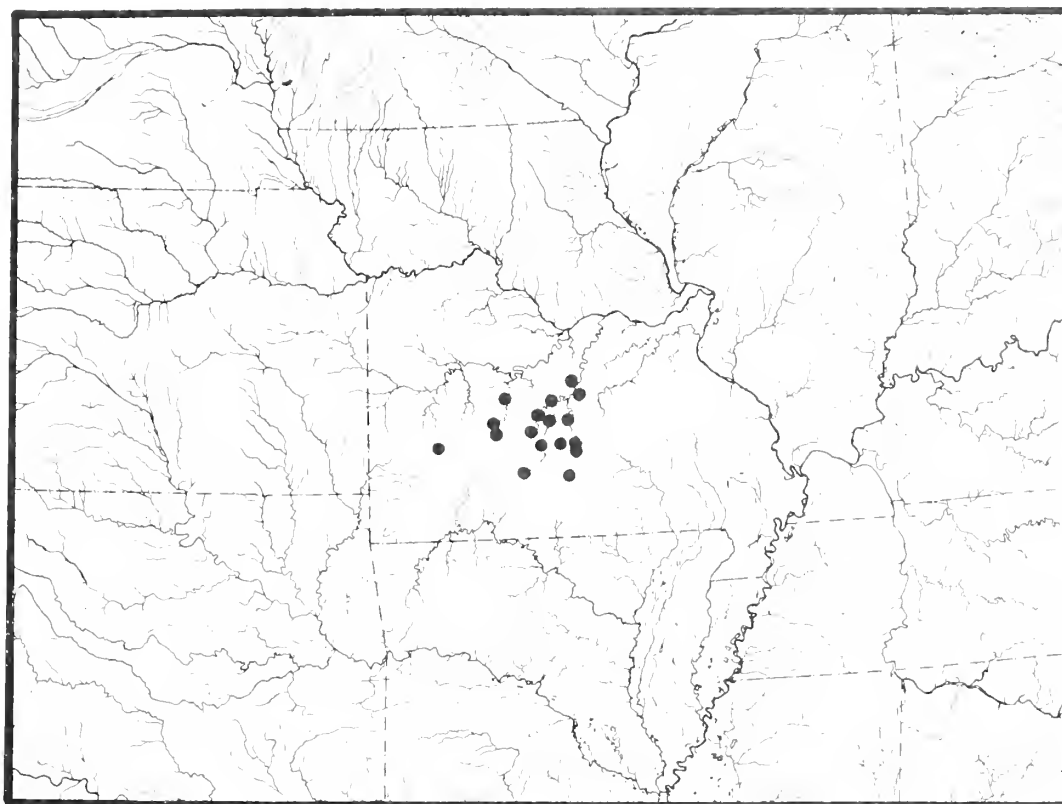
Order Perciformes
Family Percidae

TYPE LOCALITY: Niangua River, near Marshfield, MO (Gilbert and Meek *in* Gilbert 1888. Proc. U. S. Natl. Mus. [1887] 10:47-64).

SYSTEMATICS: Ditypic subgenus *Odontopholis* (Page 1974. Copeia :66-86). Closely related to undescribed form in uplands of KY.



MO: Texas Co. Big Piney River,
79 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Limited localized distribution in Osage and Gasconade river systems, MO. Uncommon to rare in pools and eddies of medium-sized Ozarkian rivers, over sandy bottom with abundant vegetation or other types of cover (Pflieger 1975. *The Fishes of Missouri*).

BIOLOGY: Evidently spawns in May over gravel riffles. Insects may constitute its primary diet (Pflieger 1975).

ADULT SIZE: 60-85 mm SL.

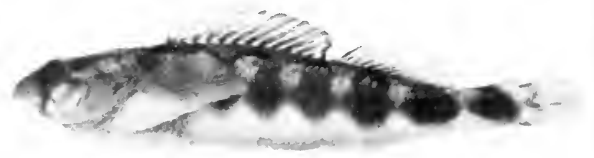
Compiler: J. R. Stauffer, Jr. October 1978.

Percina evides (Jordan and Copeland)
Gilt darter

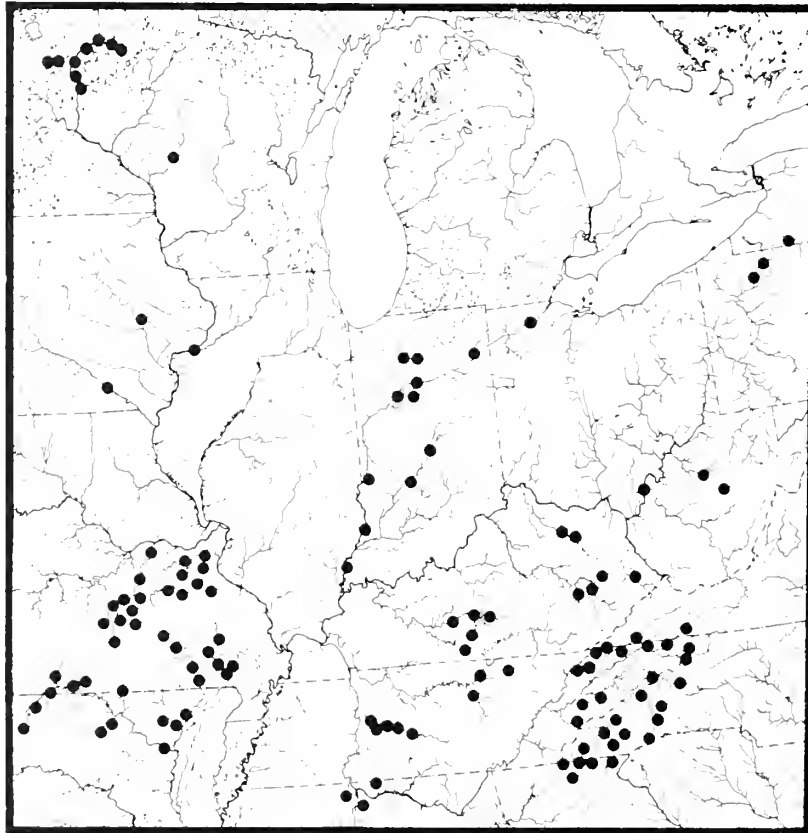
Order Perciformes
Family Percidae

TYPE LOCALITY: White River near Indianapolis, IN (Jordan and Copeland in Jordan 1877. Proc. Acad. Nat. Sci. Phila. 29:42-82).

SYSTEMATICS: Subgenus *Ericosma*. Closest relative is *P. palmaris* (Page 1974. Copeia: 66-86). Denoncourt (1969. Ph.D. diss., Cornell Univ.) examined systematics throughout range and discussed subspecific designations. Page (1974; 1976. J. Morphol. 148:255-64) discussed subgeneric relationships and Page and Whitt (1973. Ill. Nat. Hist. Surv. Biol. Notes 82:1-7; 1973. Comp. Biochem. Physiol. 44B:611-23) reported on electrophoretic studies.



TN: Sevier Co., French Broad River system, male, 54.5 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Reduced from apparent former distribution to tributaries of Ohio River in PA (Allegheny River), WV (Elk River), and KY; tributaries of Tennessee River in TN, VA, NC, and GA; and western tributaries of Mississippi River in MO and AR. Generally found in clear, moderate to small rivers and streams. Normally not in swiftest riffles or vegetation, but among loose gravel, rubble, and boulders of runs and slower riffles.

ADULT SIZE: Varies geographically. Ozark streams 52-68 mm SL, eastern tributaries of Mississippi River 50-59 mm SL.

BIOLOGY: Denoncourt (1969) summarized known information. Sexually dimorphic (males brighter, larger, more tuberculate); spawns in spring. Has typical riffle species as associates and depth/substrate varies with size of specimens.

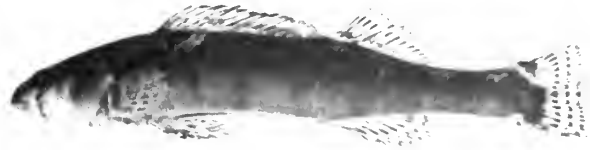
Compiler: R. F. Denoncourt. August 1979.

Percina lenticula Richards and Knapp
Freckled darter

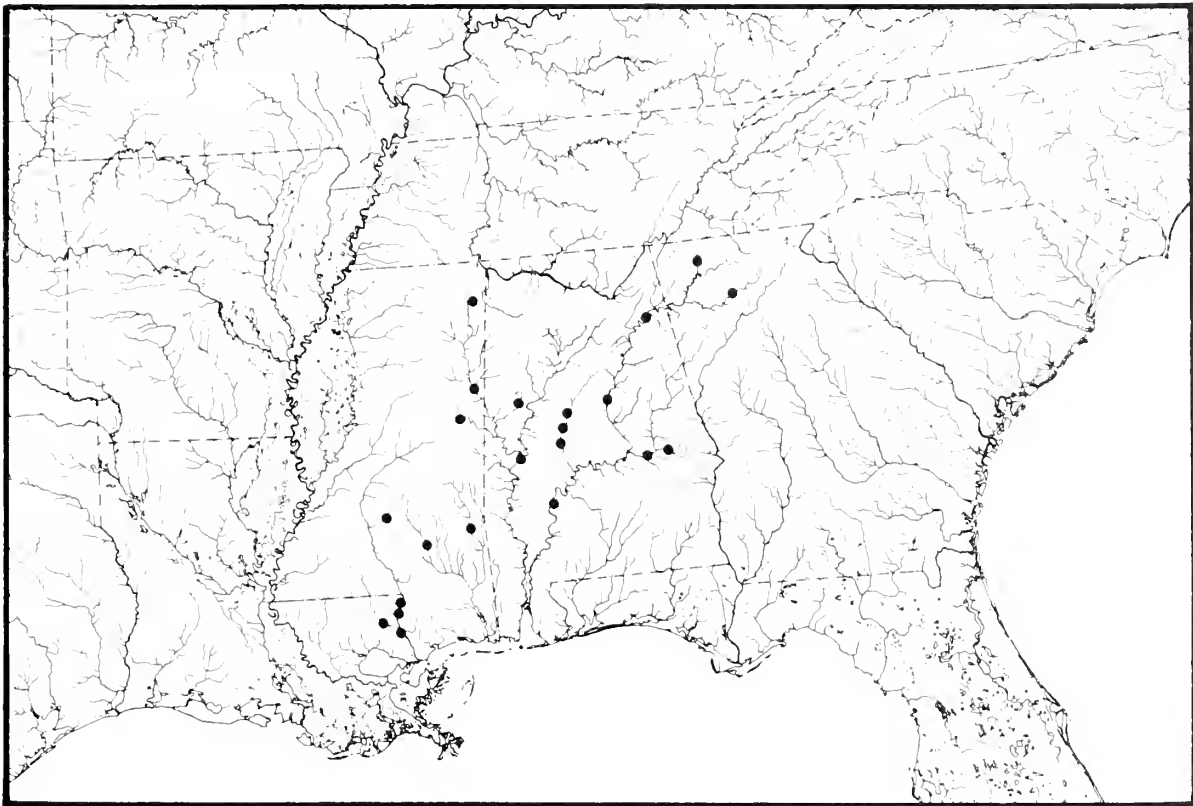
Order Perciformes
Family Percidae

TYPE LOCALITY: Cahaba River at Alabama hwy. 27, 13.7 km n of Centerville, Bibb Co., AL (Richards and Knapp 1964, Copeia: 690-701).

SYSTEMATICS: Subgenus *Hadropterus*. Closest relative is *P. sciara* of which it is considered an allopatric replacement in Mobile drainage (Richards and Knapp 1964).



AL: Tuscaloosa Co.,
Tombigbee River drainage,
Sipsey River, 137 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Uncommonly encountered. Eastern Gulf slope, from Pearl and Pascagoula river drainages to Mobile River drainage. Lives in main river channels. More commonly encountered in deepest and fastest rapids, often with substrate of uneven bedrock and potholes (Suttkus and Ramsey 1967, Tulane Stud. Zool. 13:129-45; Douglas 1968, La. Acad. Sci. 31: 41-42; Cashner et al. 1978, La. Acad. Sci. 41:9-10).

ADULT SIZE: 100-194 mm TL.

BIOLOGY: Little known. Largest member of tribe Etheostomatini, attaining 169 mm SL (Douglas 1968). Few specimens (prob-

ably less than 100) known, probably due to depth and swiftness of waters inhabited. May have occurred throughout upper Alabama River in past, and may currently occur in a few localities in this area, but pollution and extensive alteration of aquatic environments probably have eliminated it from much of the area (Suttkus and Ramsey 1967). Recently listed as endangered, rare, and threatened in LA, MS, and AL, respectively (Miller 1972, Tran. Am. Fish. Soc. 101:239-52; Miss. Game and Fish Comm., Rare and Endangered Species Comm. 1975: 1-29; Ramsey 1976, Ala. Mus. Nat. Hist. Bull. 3:53-65).

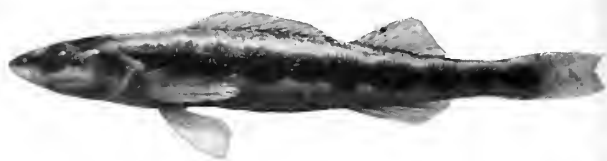
Compiler: N. H. Douglas, May 1979.

Percina macrocephala (Cope)
Longhead darter

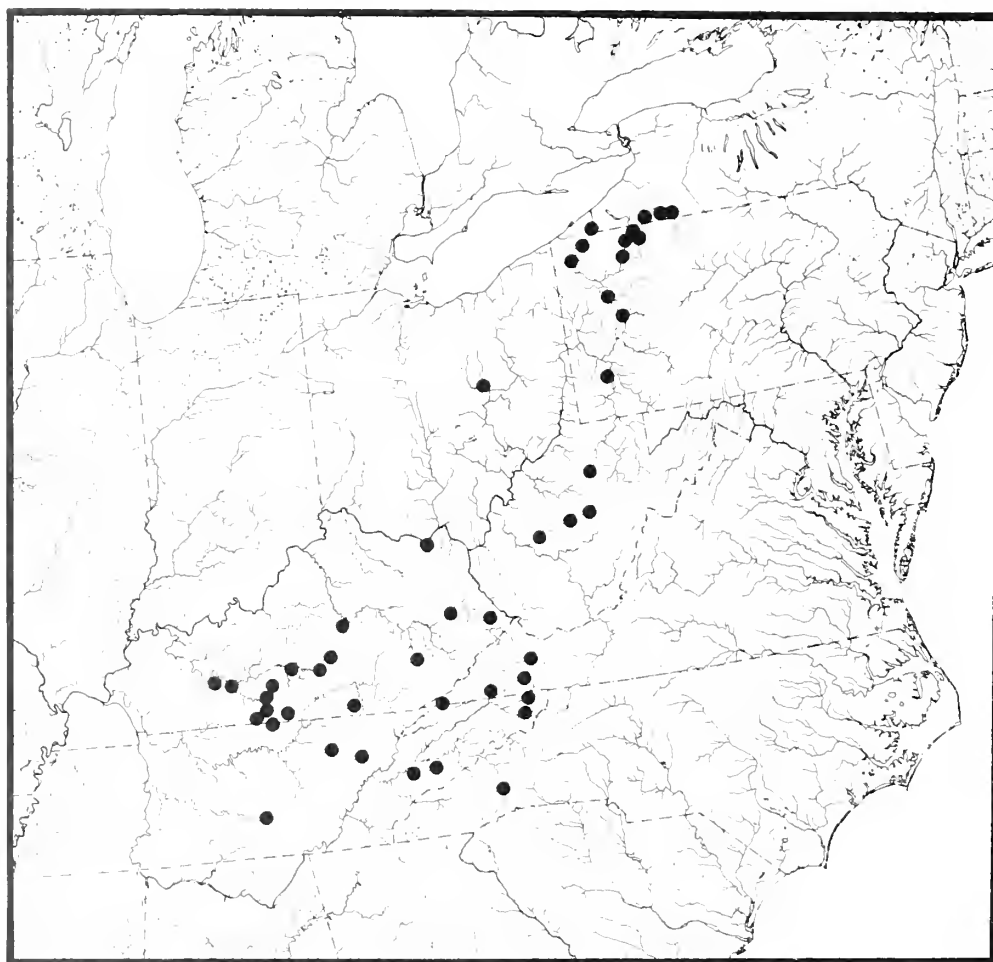
Order Perciformes
Family Percidae

TYPE LOCALITY: Youghiogheny River, PA
(Cope 1869. Trans. Am. Philos. Soc. 13:400-07).

SYSTEMATICS: Subgenus *Alvordius*. Closest described relatives are other species of subgenus inhabiting Mississippi River basin, specifically *P. maculata* and *P. pantherina* (Page 1974. Copeia :66-86). Intraspecific variation discussed by Page (1978. Copeia :655-64).



KY: Allen Co., Difficult Creek,
male, 78 mm SL (INHS)



DISTRIBUTION AND HABITAT: Uncommon in large streams and small rivers of Ohio River basin from NY to TN. Probably extirpated from OH and possibly NC. Usually in flowing pools, especially near riffles.

BIOLOGY: Page (1978) provided life history notes on Green River drainage population. Spawns March to May in KY. May live four years. Feeds on crayfishes and insect larvae.

ADULT SIZE: 65-102 mm SL.

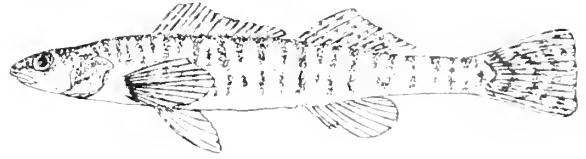
Compiler: L. M. Page. April 1978.

***Percina macrolepida* Stevenson**
Bigscale logperch

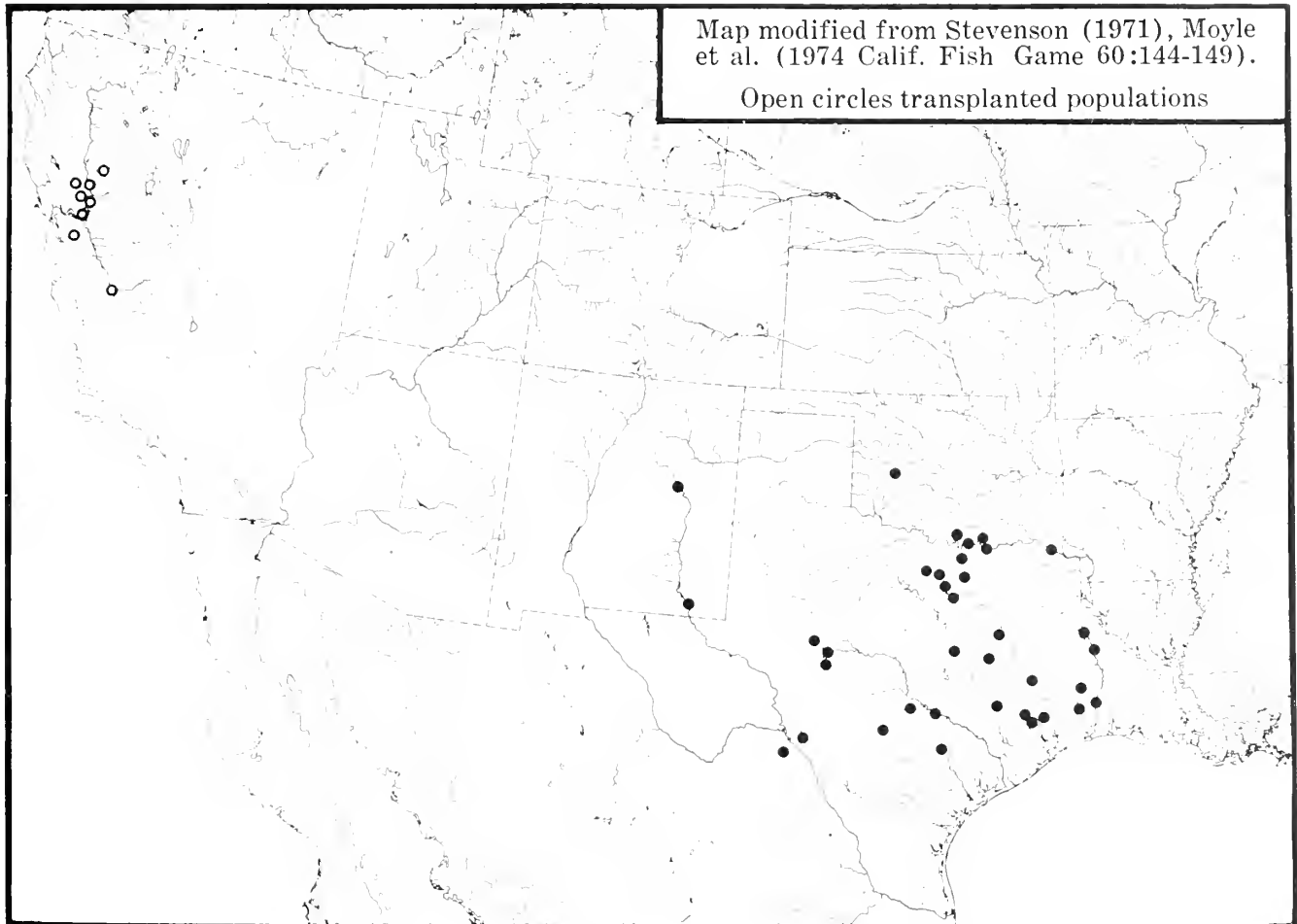
Order Perciformes
Family Percidae

TYPE LOCALITY: Guadalupe River, below dam at Kerrville State Park, 9.5 km e of Kerrville, Kerr Co., TX (Stevenson 1971. Southwest. Nat. 16:65-83).

SYSTEMATICS: Subgenus *Percina*, sibling species of *P. caprodes*. Sympatric with latter at type locality and in streams draining Edwards Plateau at eastern and western edges of escarpment. Hybridization appears minimal.



CA: Yolo Co., Putah Creek, 62 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Sabine River in eastern TX and western LA, northwest to Red and Washita rivers in OK, south to periphery of Edwards Plateau of central TX and west to Devils River in TX and Rio San Carlos, Coahuila, Mexico, and middle and upper Pecos River, NM. Introduced into Sacramento-San Joaquin drainage, CA (Sturgess 1976. Calif. Fish Game 62:79-81), where population is expanding (Moyle 1976. *Inland Fishes of California*). Not in large numbers in stream localities within natural range, and less so in sympatry with *P. caprodes*. Prefers gravel raceway conditions of moderate to swift current, avoiding rubble

riffles themselves. Can be abundant in impounded areas and is usually the only logperch present.

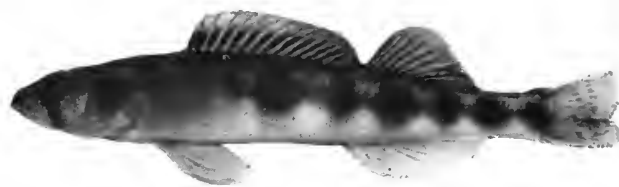
ADULT SIZE: 53-87 mm SL.

BIOLOGY: Little seasonal migration. Spawning periods and egg size and number are given for type locality specimens by Stevenson (1971). Age and growth notes, feeding and food habits, and spawning behavior for CA population given by Moyle (1976).

Compiler: M. M. Stevenson. May 1978.

Percina maculata (Girard)
Blackside darter

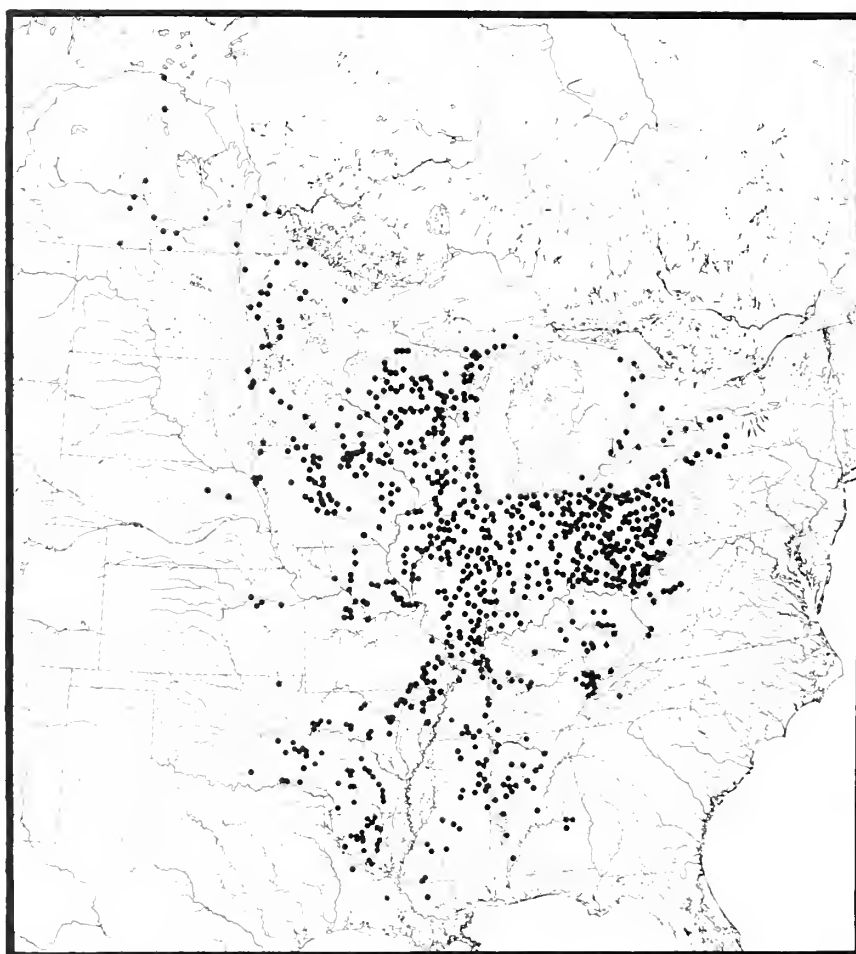
Order Perciformes
Family Percidae



TYPE LOCALITY: Fort Gratiot, Lake Huron, MI (Girard 1860. Proc. Acad. Nat. Sci. Phila. [1859] 11:56-68).

SYSTEMATICS: Subgenus *Alvordius*, E. C. Beckham (Louisiana State Univ.) is reviewing systematics. Most closely related to *P. pantherina* (Moore and Reeves 1955. Copeia:89-92; Page 1974. Copeia: 66-86).

IL: Piatt Co., East Lake Fork,
66 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Widely distributed in Mississippi basin, Gulf slope from LA to AL, Red River of North drainage, and Great Lakes basin. Often found in clear, gravelly streams and also taken in turbid ON streams. Prefers pools with some current, or even quiet pools, to swift riffles.

ADULT SIZE: 38-79 mm TL.

BIOLOGY: Spawning behavior studied by Petravicz (1938. Copeia: 40-44) and Winn (1958. Am. Midl. Nat. 59:190-212). Turner (1921. Ohio. J. Sci. 22:41-62) reported mayfly and midge larvae, copepods, corixid nymphs, and fish in stomachs in OH.

Compilers: E. C. Beckham and S. P. Platania,
June 1978.

Percina nasuta (Bailey)
Longnose darter

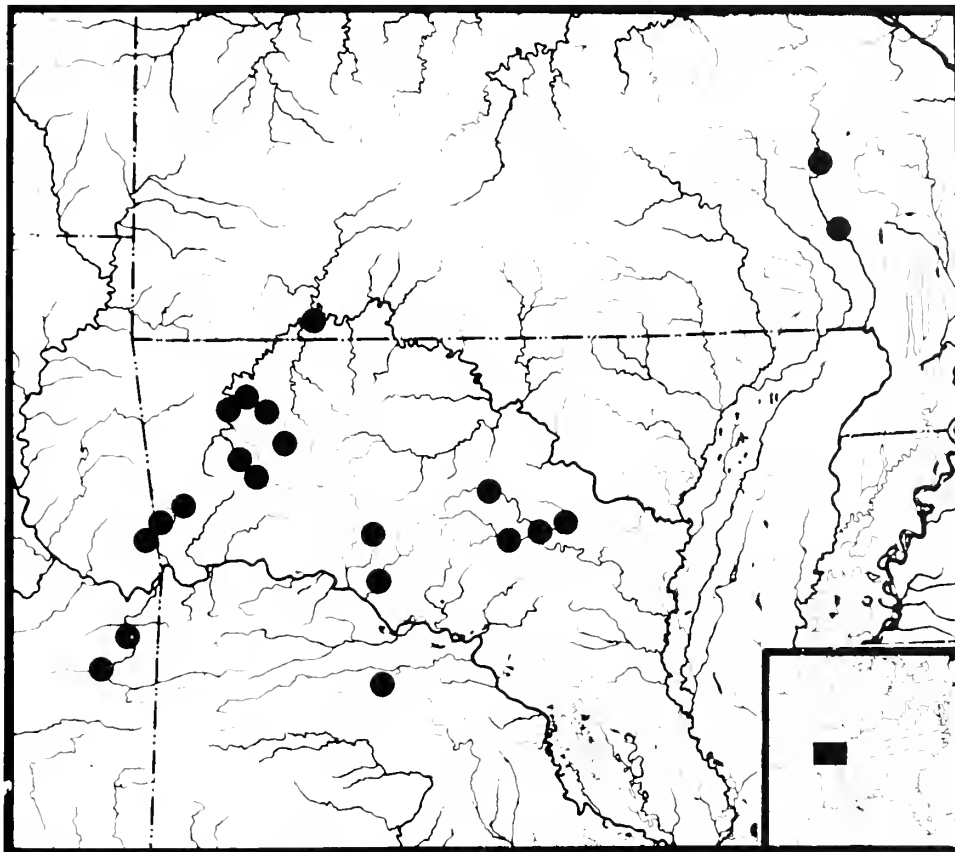
Order Perciformes
Family Percidae

TYPE LOCALITY: Middle Fork Little Red River (Tributary to White River) near the bridge at U.S. hwy. 64, 2.42 km se of Leslie, Searey Co., AR (Bailey 1941. Occas. Pap. Mus. Zool. Univ. Mich. 440:1-8).

SYSTEMATICS: Subgenus *Swainia*. Considered most specialized member of subgenus by Page (1974. Copeia: 66-86) and Thompson (1977. Ph.D. diss., Tulane Univ.). Populations considered as southern race (Thompson 1977) now recognized as separate undescribed species (Thompson 1978. Abstr. 58 Annu. ASIH meetings).



AR: Perry Co., South Fork of Fourche LaFave, male, 89 mm SL (B. A. Thompson).



DISTRIBUTION AND HABITAT: Confined to White and Arkansas river systems in Ozark uplands of MO, AR, and OK. Found in gravel and rubble riffles in spring of year, but migrates to slower, quieter waters over sand and silt in fall.

ADULT SIZE: 70-89 mm SL.

BIOLOGY: Nothing published on reproduction or food habits. Thompson (1977) speculated that spawning occurred in late April and May.

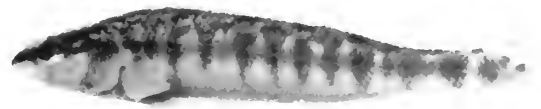
Compiler: B. A. Thompson. May 1979.

Percina nigrofasciata (Agassiz)
Blackbanded darter

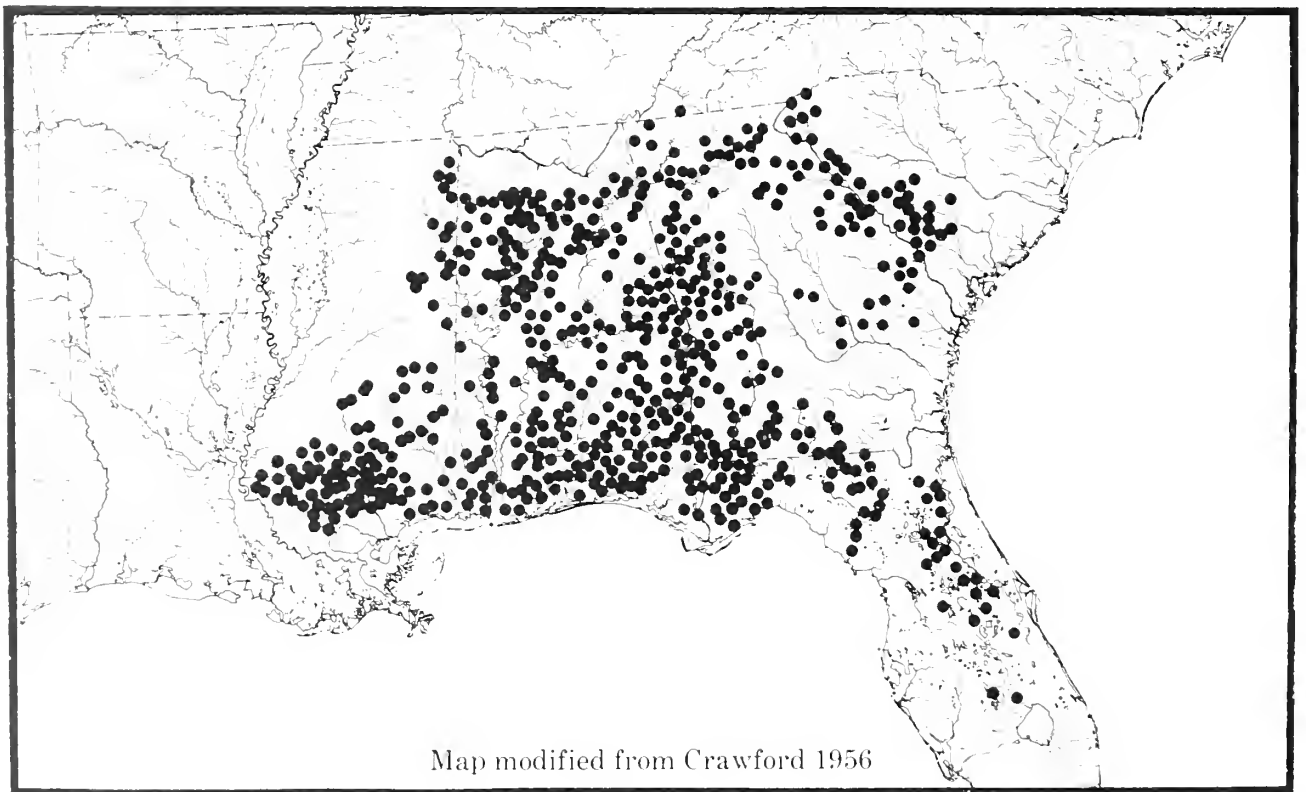
Order Perciformes
Family Percidae

TYPE LOCALITY: Near Mobile, AL (Agassiz 1854. Am. J. Sci. Arts [Ser. 2] 17:297-308, 353-69).

SYSTEMATICS: Subgenus *Hadropterus*. Most closely related to *P. sciera* and *P. aurolineata* (Page 1974. Copeia:66-86), Crawford (1956. Tulane Stud. Zool. 4:1-55) considered Fowler's (1942. Not. Nat. 107:1-11) subspecies *P. n. westfalli* as only racially distinct, and recognized two subspecies, *P. n. nigrofasciata* and *P. n. rancyi*. The latter has not gained wide acceptance in subsequent literature. Hybridizes with *P. sciera* (Suttkus and Ramsey 1967. Tulane Stud. Zool. 13: 129-45).



AL: Monroe Co., Alabama
River system, male, 60 mm SL
(Smith-Vaniz 1968).



Map modified from Crawford 1956

DISTRIBUTION AND HABITAT: Found throughout Gulf and southern Atlantic Coastal Plain drainages from eastern tributaries of lowermost Mississippi River east to Edisto River, SC, and St. Johns and Kissimmee rivers in peninsular FL. Absent from St. Marys and Satilla rivers in southeastern GA, and apparently uncommon in Altamaha drainage. Also occurs in Cumberland Plateau, Piedmont, and Ridge and Valley provinces in Tombigbee, Alabama, Apalachicola, Savannah, and Edisto drainages. Most common over gravel, but also found on sand bottom near debris.

ADULT SIZE: 39-80 mm SL, 93 mm SL maximum.

BIOLOGY: Life history information essentially confined to observations of Mathur (1973. Am. Midl. Nat. 89:381-93; 1973. Trans. Am. Fish. Soc. 102:48-55) in AL. Species is a diurnal, visual, subsurface feeder, highly insectivorous, feeding predominantly on immature diptera, ephemeroptera, and trichoptera. Sexual dimorphism and dichromatism are distinctive, and melanophore patterns change rapidly in response to background color. Spawns May to June; egg number increases with body length. Largest individuals (>60 mm TL) predominantly males.

Compiler: G. H. Burgess, October 1978.

Percina notogramma (Raney
and Hubbs)
Stripeback darter

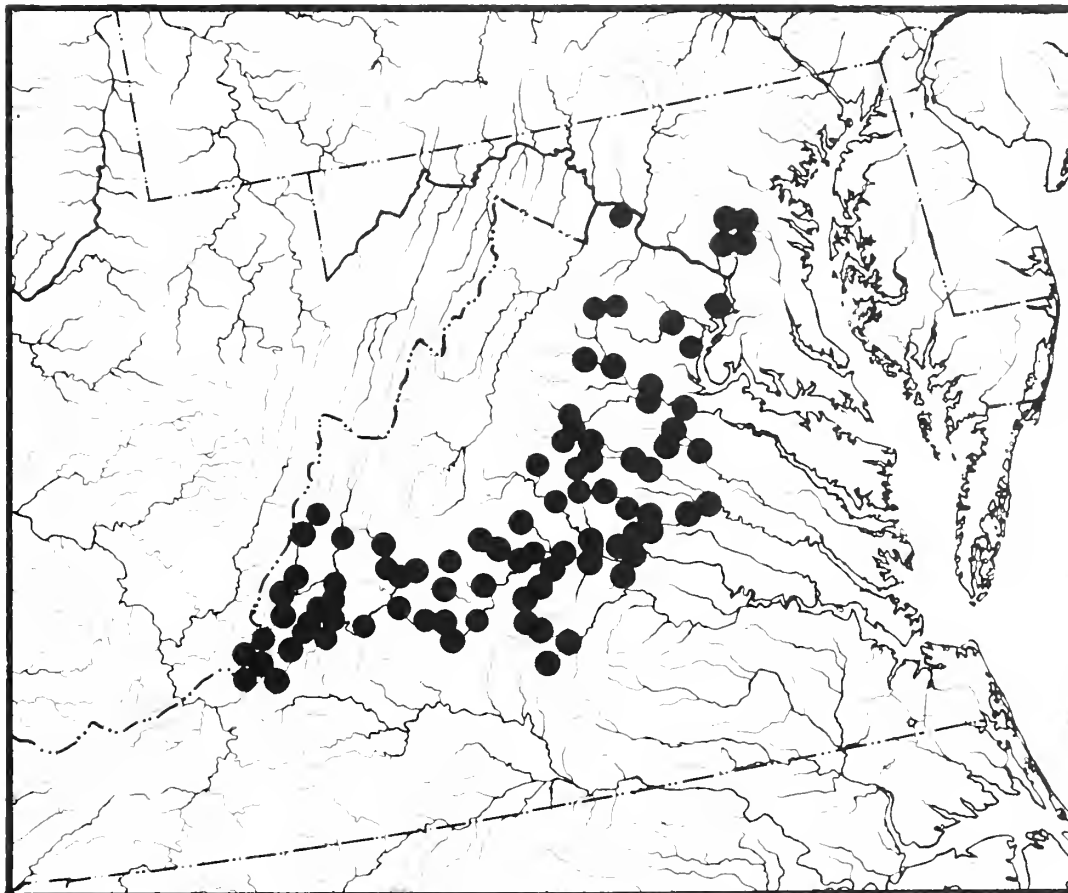
Order Perciformes
Family Percidae

TYPE LOCALITY: Invalidly designated by Raney and Hubbs (1948, *Occas. Pap. Mus. Zool. Univ. Mich.* 512:1-26). Type locality is eastern tributary Potomac River, Anne Arundel Co., MD (Collette and Knapp 1967, *Proc. U.S. Natl. Mus.* [1966] 3550:1-88).

SYSTEMATICS: Subgenus *Alvordius*; member of blackside darter group. Hogarth and Woolcott (1966, *Chesapeake Sci.* 7:101-09) described *P. notogramma montuosa*, a subspecies from upper James drainage.



MD: Prince Georges Co.,
Anacostia River, 69 mm TL
(NCSM).



Map modified from Hogarth and Woolcott 1966

DISTRIBUTION AND HABITAT: Occupies a relatively limited range along mid-Atlantic slope, from James River drainage (including Appomattox) in VA and extreme eastern WV north to Patuxent drainage in MD. May be extirpated from MD. Riffles and pools of small and medium-sized streams appear to provide favorable habitat.

BIOLOGY: Flemer and Woolcott (1966, *Chesapeake Sci.* 7:75-89) provided information on food habits. Loos and Woolcott (1969, *Copeia*:374-85) compared reproductive ecology and behavior with *P. peltata*, and discussed hybridization in South Anna River, VA.

ADULT SIZE: 45-70 mm SL.

Compiler: D. S. Lee. May 1978.

Percina ouachitae (Jordan and
Gilbert)
Yellow darter

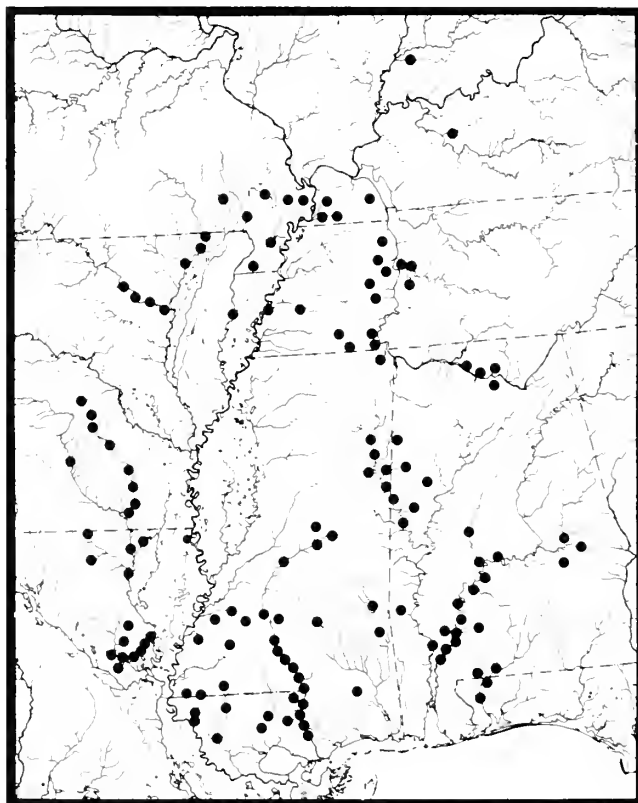
Order Perciformes
Family Percidae

TYPE LOCALITY: Saline River at Benton,
AR (Jordan and Gilbert in Gilbert 1887.
Proc. U.S. Nat. Mus. 10:47-64).



SYSTEMATICS: Subgenus *Imostoma*. Most
advanced member of "saddle-back" species
group. Incorrectly synonymized with *P.*
uranidea by Hubbs and Black (1940. Occas.
Pap. Mus. Zool. Univ. Mich. 416:1-30); resur-
rected by Thompson and Cashner (1975. Abst.
55th Ann. ASIH meetings).

AL: Escambia Co., Escambia
Creek, 50 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Gulf
slope from Escambia River, FL and AL,
west to Lake Pontchartrain, LA, north on
east side of Mississippi River to central
Tennessee River and small Mississippi River
tributaries in western KY. West side of
Mississippi River from lowland ditch system
in southeast MO south to Red River system
in northern LA. Apparently extinct in Green
River of KY and Wabash River in IL and IN.
Common to abundant in gravel and sand-
gravel bottomed riffles and runs. Rarely
in pools or quiet waters; avoids silted
areas. Prefers larger streams and rivers.

ADULT SIZE: 40-60 mm SL.

BIOLOGY: Although abundant in certain
habitats, little is known of biology. Collette
(1965. Proc. U.S. Natl. Mus. 117:567-614)
noted seasonal development of breeding
tubercles and postulated spawning peak
during first half of February. Thompson
(1974. ASB Bull. 21:87) compared diet with
that of *P. uranidea* and found more "typical"
darter diet of insect larvae and micro-
crustaceans.

Compilers: B. A. Thompson and R. C. Cashner.
May 1979.

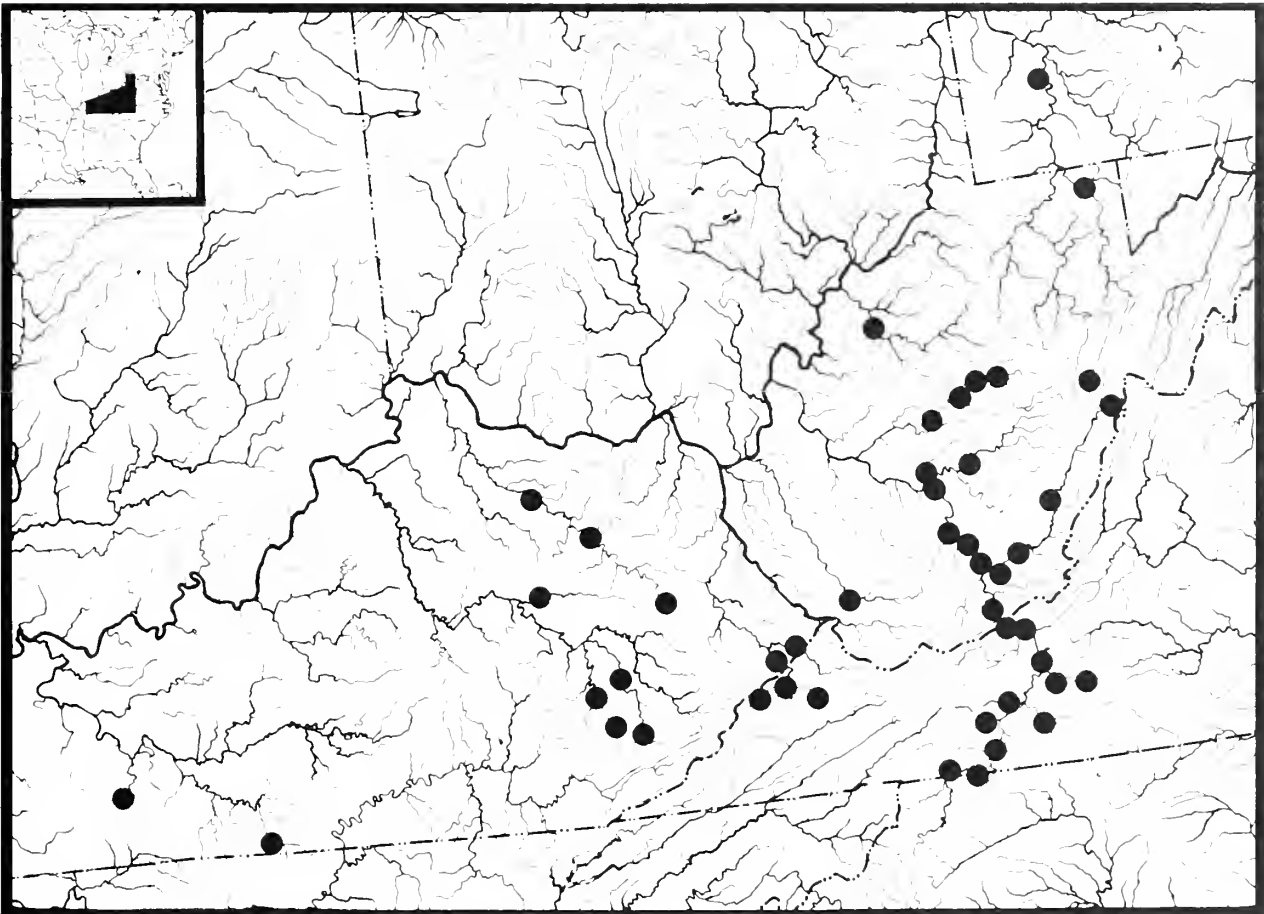
Percina osyrhyncha (Hubbs and
Raney)
Sharpnose darter

Order Perciformes
Family Percidae

TYPE LOCALITY: Cheat River at Cheat Bridge, Randolph Co., WV (Hubbs and Raney 1939, Ocas. Pap. Mus. Zool. Univ. Mich. 396:1-9).

SYSTEMATICS: Subgenus *Swainia*. Listed by Page (1974, Copeia:66-86) as primitive relative of *P. squamata*, but considered to be more advanced offshoot of *P. phoxocephala* by Thompson (1978, Abstr. 58 Ann. ASIH meetings). Denoncourt et al. (1977, Copeia: 168-71) provided detailed description and discussed sexual dimorphism. Hocutt and Hambrick (Am. Midl. Nat. 90:397-405) reported hybridization with *P. roanoka*.

WV: Raleigh Co., New River,
57 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Southern tributaries of upper Ohio River from Monongahela southwest, including Little Kanawha, New, Guyandot, Big Sandy, Licking, Kentucky, and Green rivers. Denoncourt et al. (1977) indicated specimens taken from wide range of habitats, noting definite correlation of specimen size with substrate and gradient. Adults prefer deep, fast flowing riffle-runs with gravel and rubble bottoms, often near boulders; smaller individuals usually found in shallower areas over sand and gravel, often in slow current.

ADULT SIZE: 70-97 mm SL.

BIOLOGY: Nothing published. Thompson (1977, Ph.D. diss., Tulane Univ.) presented evidence of spawning from late April to possibly early June.

Compiler: B. A. Thompson, May 1979.

Percina palmaris (Bailey)
Bronze darter

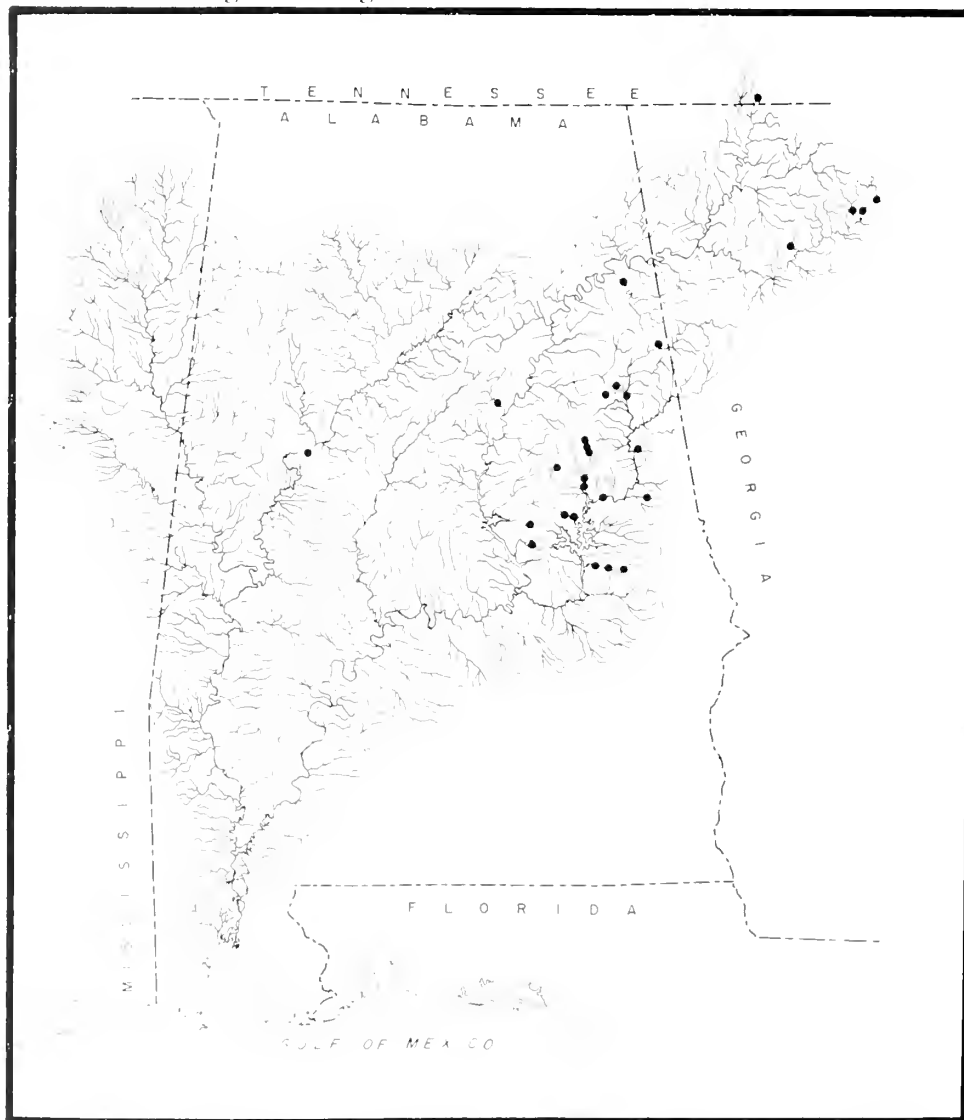
Order Perciformes
Family Percidae

TYPE LOCALITY: Etowah River, 6.5 km sw of Dahlonega, just above U.S. hwy. 19 bridge, Lumpkin Co., GA (Bailey 1940, J. Wash. Acad. Sci. 30:524-30).

SYSTEMATICS: Subgenus *Ericosma*. Page (1974, Copeia:66-86) discussed subgeneric relationship of *Percina*. Page and Whitt (1973, Ill. Nat. Hist. Surv. Biol. Notes 82:2-7) reported on electrophoretic studies. Crawford (1954, Copeia:235-36) and Denoncourt (1976, Copeia:54-59) analyzed meristic and morphometric variation throughout range.



GA: Floyd Co., Coosa River system, 74 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Riffles of Coosa and Tallapoosa systems of Mobile Bay drainage AL, GA, and TN. Inhabits clean, fast riffles having rubble-gravel substrate.

BIOLOGY: Sexual dimorphism and tuberculation described by Denoncourt (1976); tuberculation suggests spawning late spring or early summer.

ADULT SIZE: 55-75 mm SL.

Compiler: R. F. Denoncourt, May 1978.

Percina pantherina (Moore and
Reeves)
Leopard darter

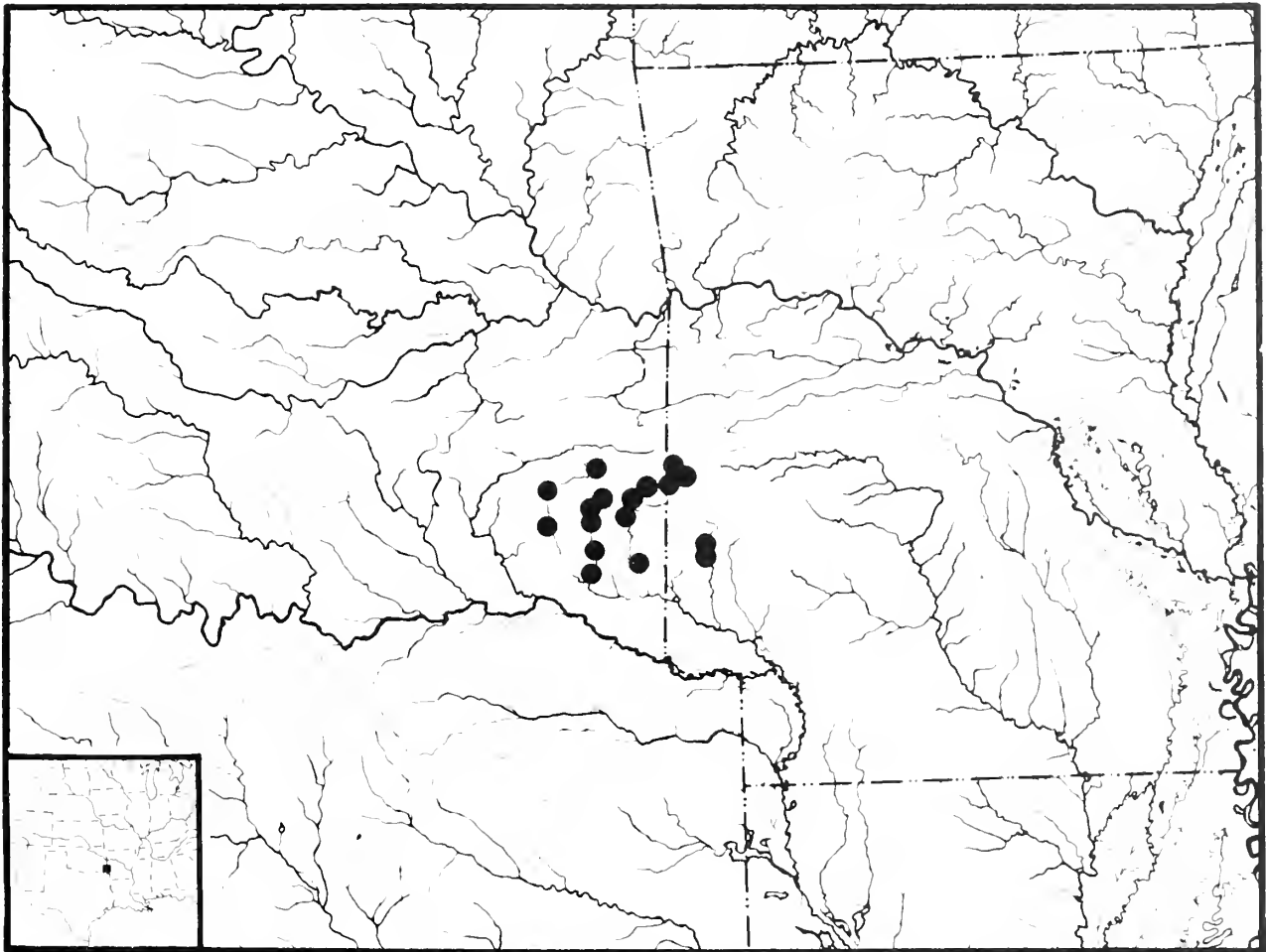
Order Perciformes
Family Percidae

TYPE LOCALITY: Little River w of
Piekens, T2S, R20E, Sec. 1, Pushmataha
Co., OK (Moore and Reeves 1955, Copeia:
89-92).

SYSTEMATICS: Subgenus *Alvordius*.
Most closely related to *P. maculata* (Moore
and Reeves 1955; Page 1974, Copeia:66-86).



AR: Sevier Co., Cossatot River,
male (H. W. Robison).



DISTRIBUTION AND HABITAT: Upland
streams and rivers of Little River system
of southeastern OK and southwestern AR.
Generally in moderately swift riffles
from 25 cm to less than 90 cm in depth over
medium to large gravel and cobble-sized
rocks. Also taken in shallow pool areas 25 cm
to 60 cm over cobble-sized rocks through
which flows some current, and occasionally
along edges of *Justicia americana* beds.
ADULT SIZE: 32.0-76.8 mm SL.

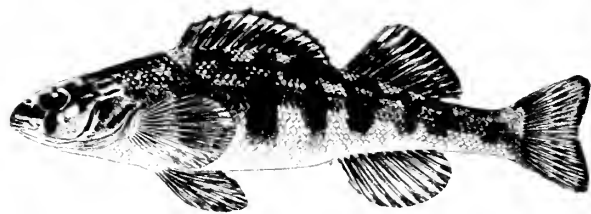
BIOLOGY: Robison (1978, Endangered
Species Report No. 3, U.S. Fish Wildl.
Serv.: 1-28) reported the following: foods
include blackfly (*Simulium*) larvae, Chi-
ronomidae and Chaoboridae larvae, Coleop-
tera adults, and Ephemeroptera nymphs;
largest specimens are females; oldest known
specimen three-plus years; sex ratio 1:1.04.
Number of mature ova ranged from 260-
418 with total ova ranging from 510-2302.
Compiler: H. W. Robison, January 1980.

Percina peltata (Stauffer)
Shield darter

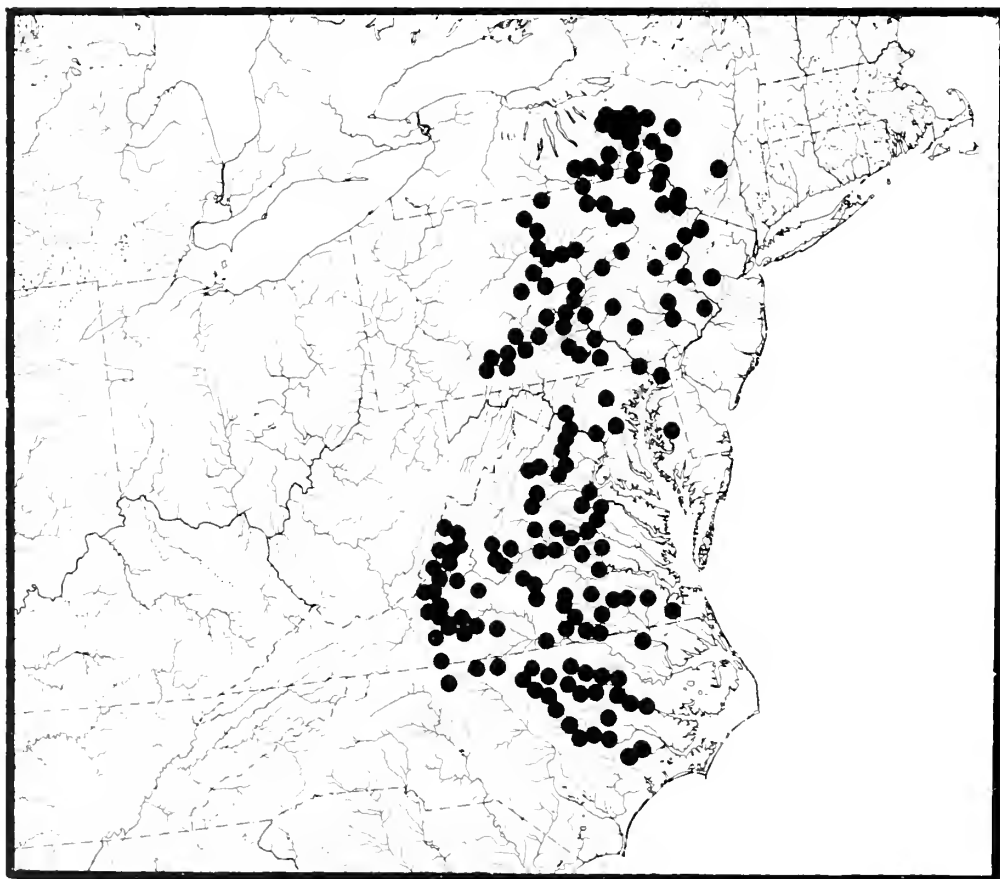
Order Perciformes
Family Percidae

TYPE LOCALITY: Conestoga River, Lancaster Co., PA (Stauffer *in* Cope 1864. Proc. Acad. Nat. Sci. Phila. 16:231-33).

SYSTEMATICS: Subgenus *Alvordius*. Hybridizes (rarely) with *P. notogramma* (Loos and Woolcott 1969. Copeia:374-85). Page (1974. Copeia: 66-86) listed values for 44 taxonomic characters. Raney and Suttkus (1948. Abstr., 28th Annual Meeting, ASIH) indicated *P. p. peltata* ranges from lower James River, VA, north to lower Hudson River, NY. *Percina p. nevisense* from Neuse and Tar rivers, NC, and an unnamed subspecies occurs in upper Roanoke River, VA.



MD: Harford Co., Deer Creek,
62 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Atlantic slope streams from NY to NC. Inhabits riffles of small to large streams and rivers with rubble and gravel bottoms, from mountains to Coastal Plain. Adults usually avoid mud, silt, and slow-moving water. Often fairly common.

ADULT SIZE: 48-80 mm.

BIOLOGY: New (1966. Copeia:20-28) reported aspects of reproductive behavior and habitat. Collette (1965. Proc. U.S. Natl. Mus. 117:567-614) found no breeding tubercles. Males exhibit extreme development of modified midventral scales (Page 1976. J. Morphol. 148:255-64).

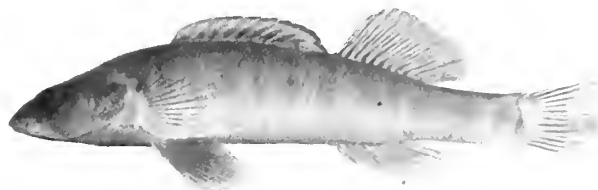
Compiler: R. W. Malick, Jr. May 1979.

Percina phoxocephala (Nelson)
Slenderhead darter

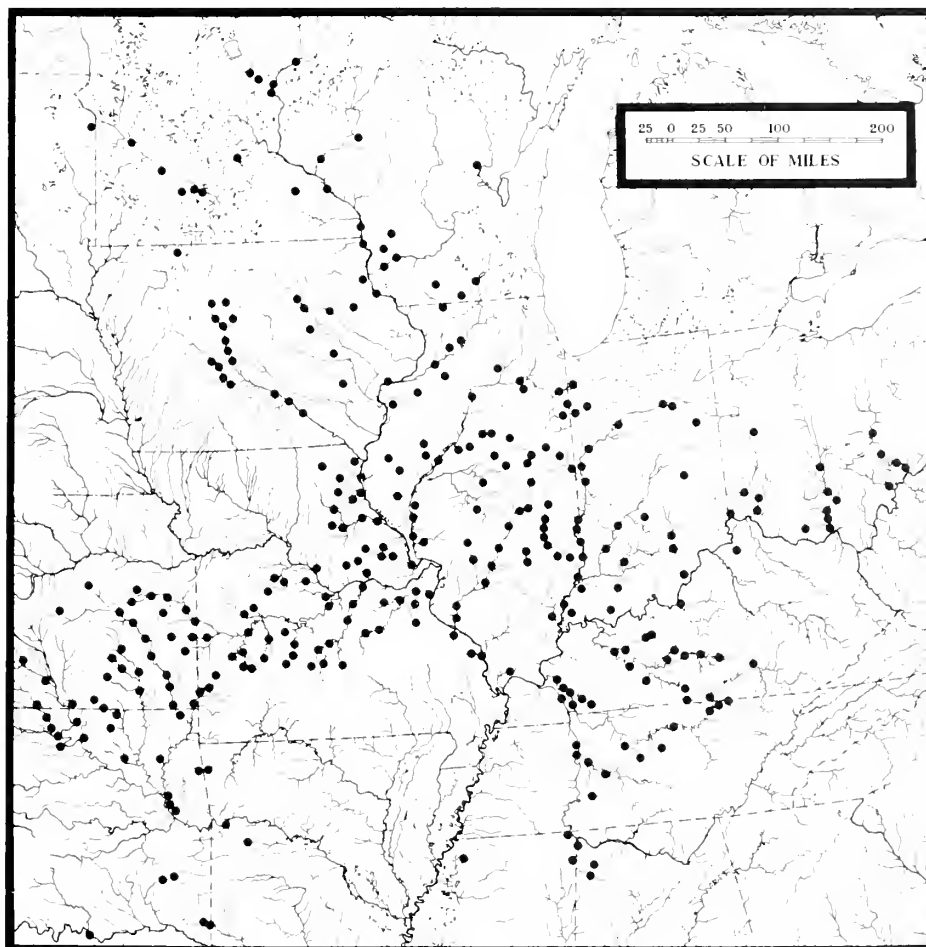
Order Perciformes
Family Percidae

TYPE LOCALITY: Illinois River and tributaries, IL (Nelson 1876. Bull. Ill. Mus. Nat. Hist. 1:33-52).

SYSTEMATICS: Subgenus *Swainia*. Listed by Page (1974. Copeia:66-86) as more advanced member of subgenus, but considered by Thompson (1978. Abstr. 58 Annu. ASIH meetings) to be most like ancestor.



MO: Lewis Co., Mississippi
River at Canton, male, 68 mm
SL (Mo. Dept. Cons.).



DISTRIBUTION AND HABITAT: Most widespread member of subgenus, occurring in Great Lakes, Mississippi, and Ohio drainages in 16 states. Somewhat plastic in habitat preference, but most common in gravel or rocky bottom riffles in fairly swift current. Moderately intolerant of silt. Can become fairly abundant in gravel and rubble runs below dams. Very few lake or reservoir records.

ADULT SIZE: 55-79 mm SL.

BIOLOGY: Reproductive habits and age and growth discussed by Karr (1963. Proc. Iowa Acad. Sci. 70:228-36), Cross (1967. Univ. Kans. Mus. Nat. Hist. Misc. Publ. 45:1-357), Thomas (1970. Ill. Nat. Hist. Surv. Biol. Notes 70:1-18) and Page and Smith (1971. Ill. Nat. Hist. Surv. Biol. Notes 74:1-14). Food habits presented by Karr (1963), Cross (1967), Thomas (1970), Page and Smith (1971) and Miller and Robison (1973. *The Fishes of Oklahoma*). Other aspects of life history covered by Thomas (1970) and Page and Smith (1971).

Compiler: B. A. Thompson. May 1979.

Percina rex (Jordan and Evermann)
Roanoke logperch

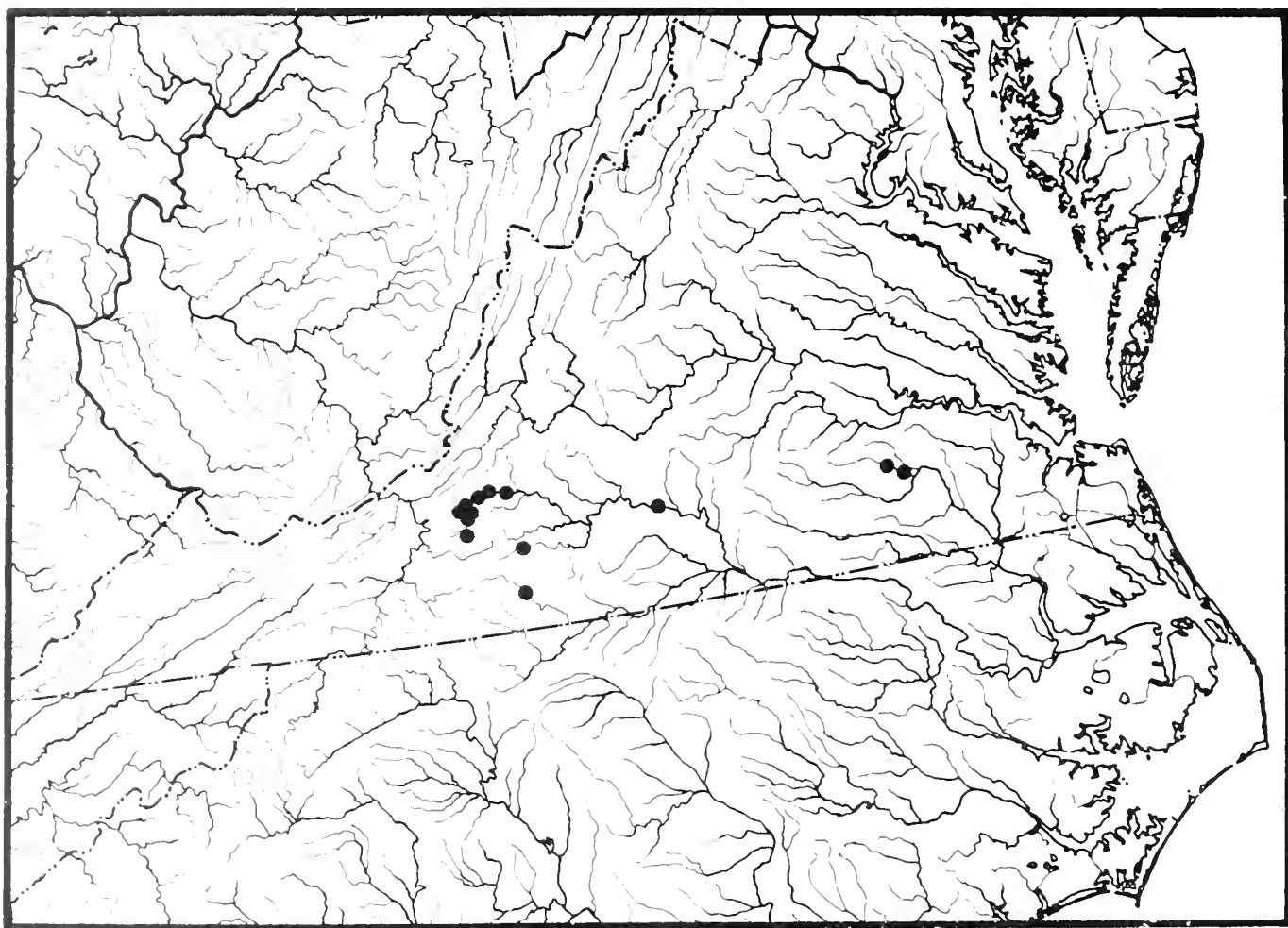
Order Perciformes
Family Percidae

TYPE LOCALITY: Roanoke River near (now within) Roanoke, Roanoke Co., VA (Jordan and Evermann in Jordan 1889. Proc. U. S. Natl. Mus. 11:351-62).

SYSTEMATICS: Subgenus *Percina*. Most closely related to *P. burtoni* and other members (Thompson 1978. ASB Bull. 25:57) of the subgenus with an orange band in the spinous dorsal fin that have been long included under the name *P. caprodes carbonaria*.



VA: Roanoke River, male, 104 mm SL (R.E. Jenkins).



DISTRIBUTION AND HABITAT: Restricted to and disjunctly distributed in Piedmont and Ridge and Valley provinces of Roanoke drainage, VA. Occupies the three main systems of drainage: Chowan, Dan, and Roanoke proper. Typically inhabits medium-sized, warm, usually clear streams, where it occupies riffles, runs, and pools with sandy to boulder-strewn bottoms but not deep silt. Generally exists in low-density populations.

ADULT SIZE: 80-115 mm SL, 117 mm SL maximum.

BIOLOGY: Consumes mainly benthic insects, often obtained after overturning stones with snout. Based on gonadal development, peak spawning probably occurs during June in upper Roanoke. Some age group II females are mature; all are mature by age IV. Oldest specimen was of age group VI.

Compilers: R. E. Jenkins, D. Ebaugh, and T. Zorach. July 1978.

Percina roanoka (Jordan and
Jenkins)
Roanoke darter

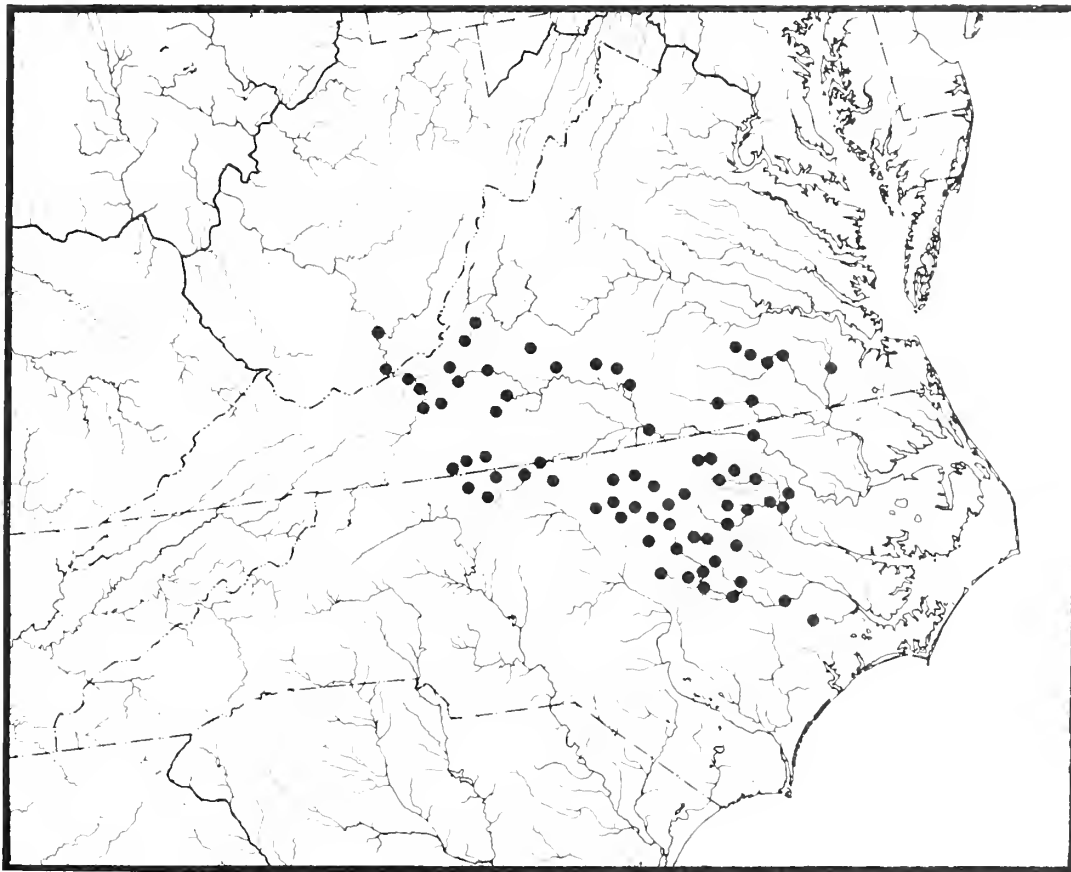
Order Perciformes
Family Percidae

TYPE LOCALITY: Bottom Creek, tributary of South Fork of Roanoke River, near Alleghany Springs, Montgomery Co., VA (Jordan and Jenkins in Jordan 1889, Proc. U.S. Natl. Mus. [1888] 11:351-62). Locality clarified by Jordan (1889, Bull. U.S. Fish Comm. [1888] 8:97-173).

SYSTEMATICS: Transferred from subgenus *Ericosma* to *Alcoridius* by Page (1974, Copeia: 66-86). Closely related to and formerly considered subspecies of *P. crassa*. Treated as specifically distinct by Page (1974). Mayden and Page (1979, Copeia :413-26) concluded that *P. roanoka* was specifically distinct from *P. crassa* and presented a thorough systematic account of the species.



VA: Franklin Co., Blackwater
River, male, 55 mm SL (INHS).



DISTRIBUTION AND HABITAT: James, Roanoke (including Chowan), Tar, and Neuse river drainages, NC and VA. Introduced in New River drainage, VA and WV (Hocutt and Hambrick 1973, Am. Midl. Nat. 90:397-405; Lachner and Jenkins 1971, Smithson. Contrib. Zool. 85:1-97). Abundant in Montane and upper Piedmont regions; less common and less widely distributed on upper Coastal Plain. Larger juveniles and adults inhabit gravel (cobble and pebble) and boulder substrates in runs and riffles of generally clear, moderate to large streams and rivers.

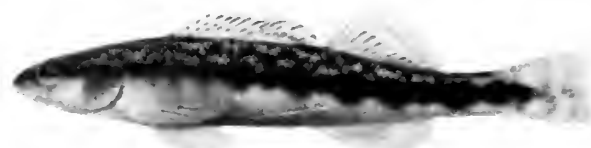
ADULT SIZE: 35-50 mm SL, 65 mm SL maximum.

BIOLOGY: Feeds diurnally on immature insects. Life span about three years. Spawns in spring. Life history aspects discussed by Hobson (in press, Bios). Hybridization with *P. oxyrhyncha* reported by Hocutt and Hambrick (1973).

Compiler: R. L. Mayden. April 1978.

Percina sciera (Swain)
 Dusky darter

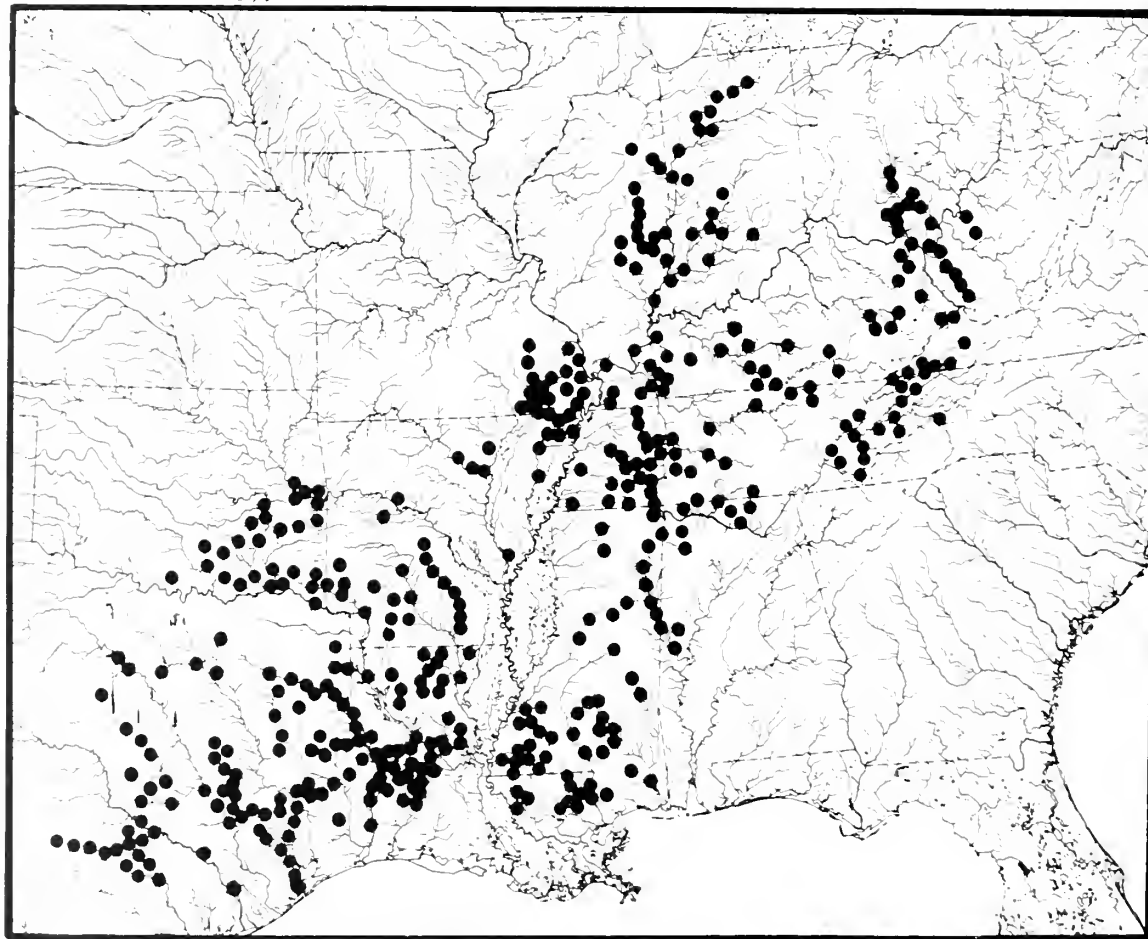
Order Perciformes
Family Percidae



TYPE LOCALITY: Bean Blossom Creek, tributary of White River, 9 km n of Bloomington, Monroe Co., IN (Swain 1883. Proc. U. S. Natl. Mus. 6:252).

SYSTEMATICS: Subgenus *Hadropterus*. Closest relatives are *P. aurolineata*, *P. lenticula*, and *P. nigrofasciata* (Richards and Knapp 1964. Copeia:690-701; Suttkus and Ramsey 1967. Tulane Stud. Zool. 13:129-45). Two subspecies recognized: *P. s. apristis* endemic to Guadalupe drainage, TX, and *P. s. sciera* (Hubbs 1954. Am. Midl. Nat. 52:211-20). Synonymy in Hubbs and Black (1954. Am. Midl. Nat. 52:201-10).

AL: Tuscaloosa Co., Black Warrior River system, 55 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Widespread and common from Guadalupe drainage, TX, east to Tombigbee-Black Warrior system, AL, and north to Wabash drainage, IL and IN, and Scioto drainage, OH. Most common over gravel or gravel and sand raceways of large streams and rivers.

BIOLOGY: Page and Smith (1970. Ill. Nat. Hist. Surv. Biol. Notes 69:1-15) discussed life history in Embarras River, IL. Suttkus and Ramsey (1967) discussed habitat and hybridization. Hubbs and Johnson (1961. Southwest. Nat. 6:9-12) provided information on number and size of eggs. Spawns in IL from May to July. Lives to about four and a half years. Diet of immature insects.

ADULT SIZE: 40-110 mm SL.

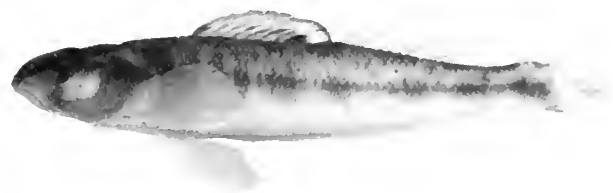
Compiler: L. M. Page. December 1978.

Percina shumardi (Girard)
River darter

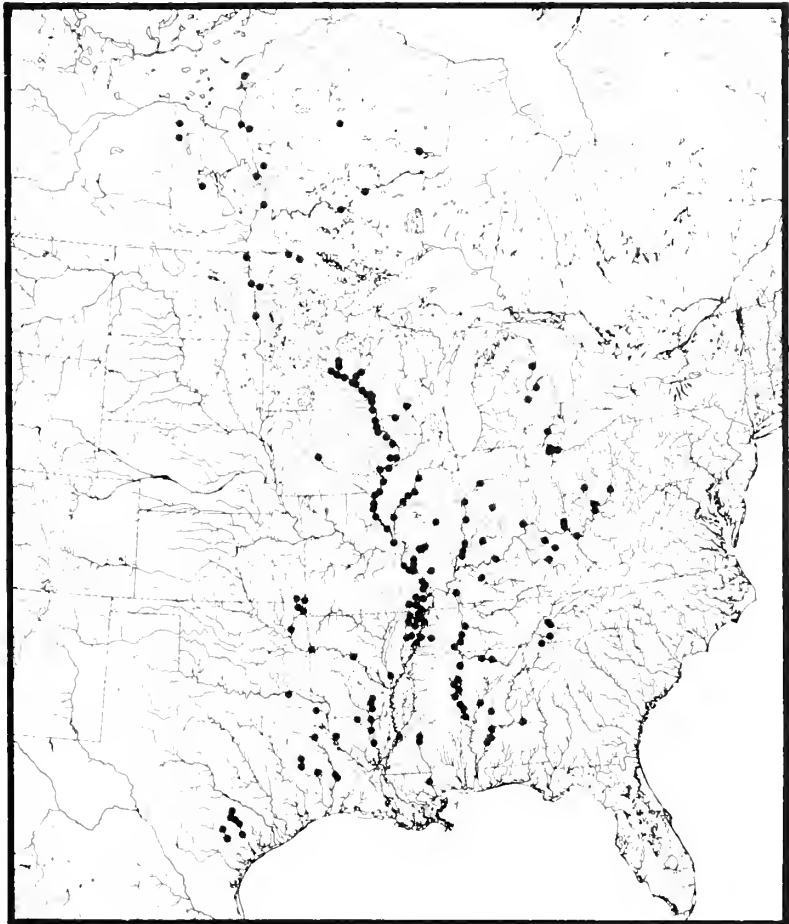
Order Perciformes
Family Percidae

TYPE LOCALITY: Arkansas River, near Fort Smith, AR (Girard 1860, Proc. Acad. Nat. Sci. Phila. [1859] 11:100-04).

SYSTEMATICS: Subgenus *Imostoma*. Etnier (1976, Proc. Biol. Soc. Wash. 88:469-88) discussed relationships and provided key to subgenus. Study of infraspecific variation not yet published.



AL: Bibb Co., Cahaba River,
63 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Gulf Coast (San Antonio Bay to Mobile Bay drainages) north in Mississippi Valley (Mississippi River and most major tributaries) to Lake Erie and Lake Huron drainages and Red River of North and certain other Hudson Bay drainages of Canada. Population in San Antonio Bay drainage, TX, widely disjunct from next closest population, in Sabine River, TX and LA. Confined to large rivers and lower parts of major tributaries. Almost invariably found in deep chutes and riffles where current swift and bottom composed of coarse gravel or rock. Seems more tolerant of turbidity than most darters.

ADULT SIZE: 45-65 mm TL, 73 mm TL maximum.

BIOLOGY: Thomas (1970, Ill. Nat. Hist. Surv., Biol. Notes 70:1-18) studied biology in IL, and his data were summarized by Pflieger (1975, *The Fishes of Missouri*). Diet principally midge and caddisfly larvae. Spawning habits not known, but in IL spawning occurs April and May. Thomas (1970) found no individuals over two years old (based on limited sample). Hubbs (1967, Tex. Mem. Mus. Bull. 13:1-72) reported on hybridization experiments.

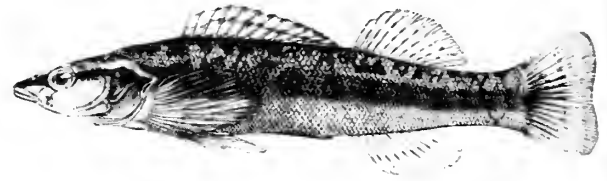
Compiler: C. R. Gilbert, November 1978.

Percina squamata (Gilbert and Swain)
Olive darter

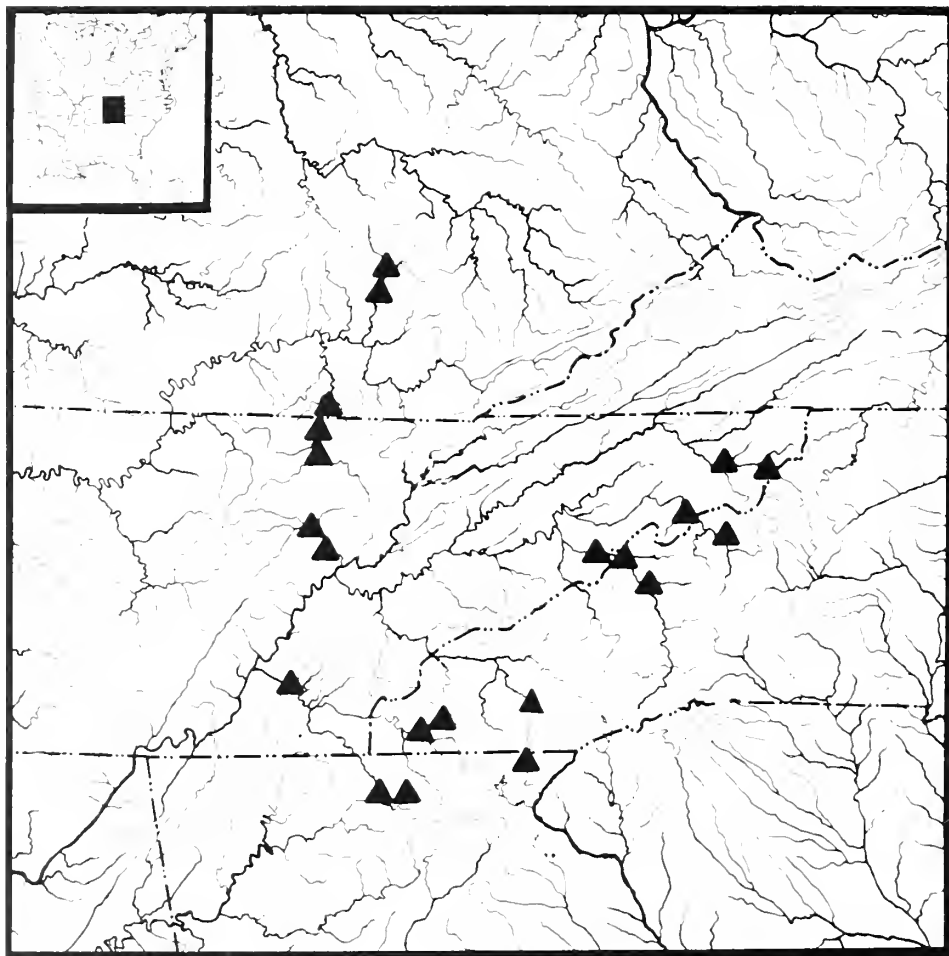
Order Perciformes
Family Percidae

TYPE LOCALITY: French Broad River at mouth of Wolf Creek, Cocke Co., TN (Gilbert and Swain *in* Gilbert 1887. Proc. U.S. Natl. Mus. 10:47-64).

SYSTEMATICS: Subgenus *Swainia*. Considered primitive by Page and Smith (1971. Ill. Nat. Hist. Surv. Biol. Notes 74:1-14) but more advanced by Thompson (1977. Ph.D. diss., Tulane Univ.). Two distinctive races recognized by Thompson (1977), one in Cumberland River, the other in Tennessee system.



NC: Cherokee Co., Valley River, 85 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Rockcastle and Big South Fork rivers in Cumberland system, with widely disjunct populations in Upper Tennessee River system. Can be common in deep, swift rapids and runs near boulders in main river channels (Comiskey and Etnier 1972. J. Tenn. Acad. Sci. 11:140-45; Thompson 1977).

ADULT SIZE: 70-108 mm SL.

BIOLOGY: Nothing published. Thompson (1977) looked at limited aspects of spawning and population structure.

Compiler: B. A. Thompson. May 1979.

Percina tanasi Etnier
Snail darter

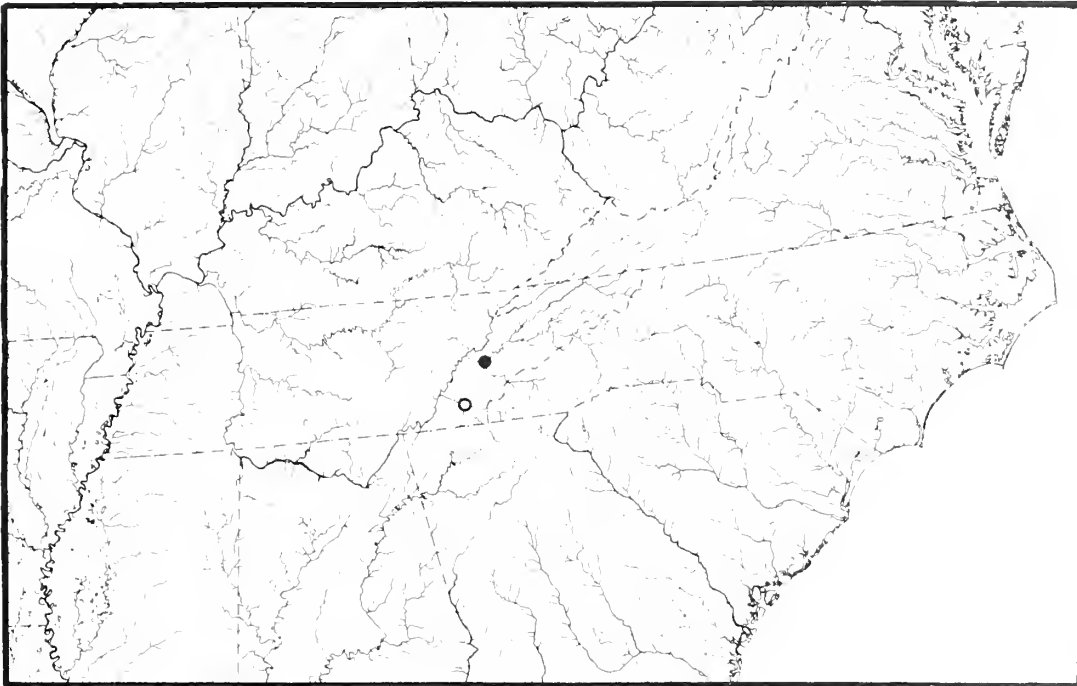
Order Perciformes
Family Percidae

TYPE LOCALITY: Little Tennessee River (river km 11), Coytee Spring, Loudon Co., TN (Etnier 1976, Proc. Biol. Soc. Wash. 88:469-88).

SYSTEMATICS: Subgenus *Imostoma* (Etnier 1976). Most closely related to *P. uranidea* of central Mississippi Valley.



TN: Loudon Co., Little Tennessee River, 63 mm SL (R.T. Bryant, Jr.).



Open circle transplanted population

DISTRIBUTION AND HABITAT: Restricted to lower 32 km of Little Tennessee River. Introduced into Hiwassee River, Polk Co., TN. Inhabits gravel shoals (Etnier 1976). Starnes (1977, Tenn. Wildl. Res. Agency Tech. Rept. 52:1-143) studied various aspects of life history and biology.

ADULT SIZE: 75 mm TL.

BIOLOGY: Feeds primarily on gastropods (Starnes 1977). Hatching young drift downstream 10-20 km or more before returning to spawning shoals (Hickman and Fitz 1978, TVA Tech. Note B28).

Compiler: D. A. Etnier, February 1979.

Percina uranidea (Jordan and Gilbert)
Stargazing darter

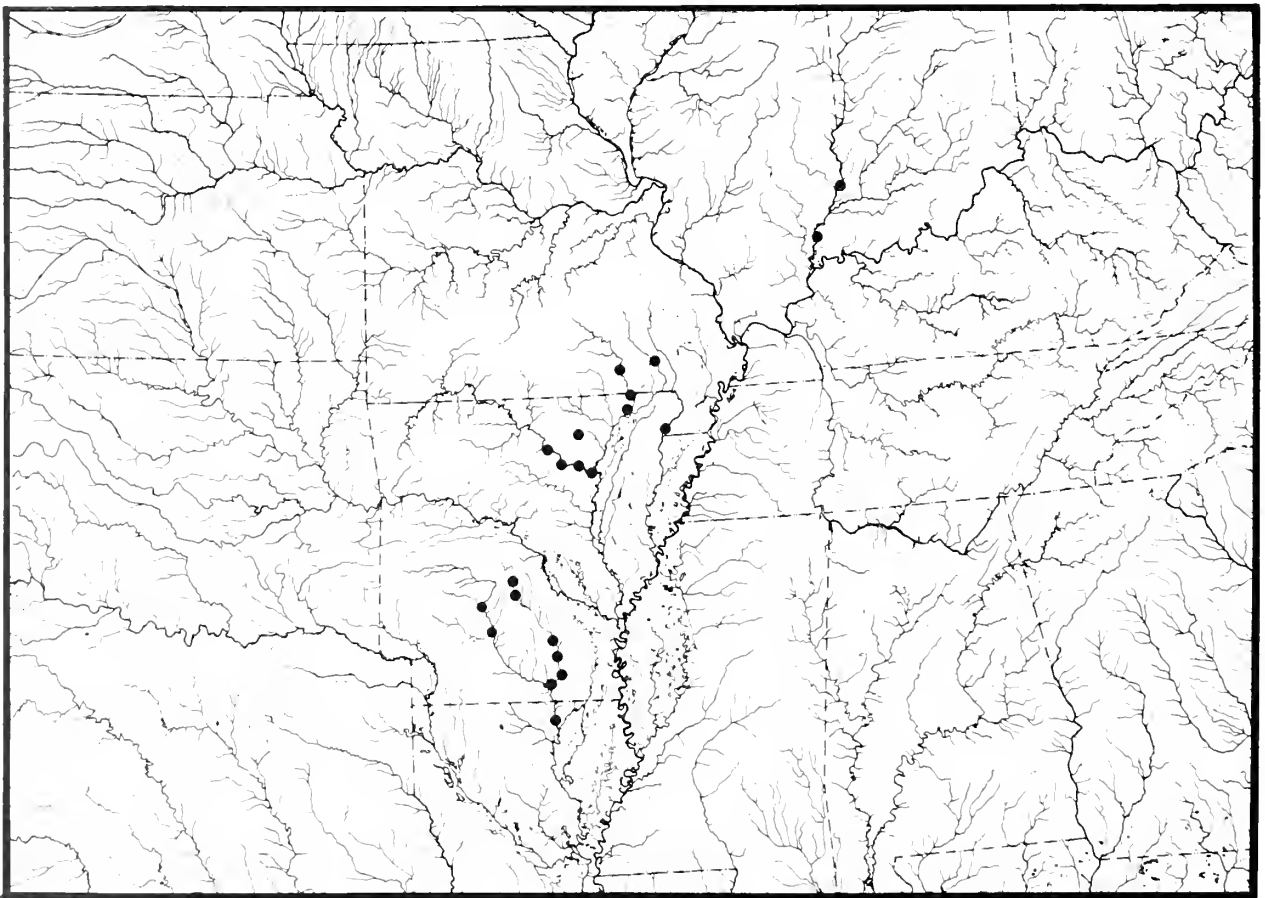
Order Perciformes
Family Percidae

TYPE LOCALITY: Washita (=Ouachita) River at Arkadelphia, AR (Jordan and Gilbert in Gilbert 1887. Proc. U.S. Natl. Mus. 10:47-64).

SYSTEMATICS: Subgenus *Imostoma*. Most primitive member of "saddle-back" species group. Confused in past literature with *P. ouachitae* due to name reversal (see *Percina ouachitae*). Thompson and Cashner (in Douglas 1974. *Freshwater Fishes of Louisiana*) and Thompson (1974. ASB Bull. 21:87) first differentiated the two species. Etnier (1976. Proc. Biol. Soc. Wash. 88:469-88) discussed relationships and provided key to subgenus.



AR: Randolph Co., Current River, female, 65 mm SL (B. A. Thompson).



DISTRIBUTION AND HABITAT: Western tributaries of Mississippi River from northern LA (Ouachita River) to northeastern AR and southeastern MO (White River). Apparently extinct in Wabash River IN and IL. Inhabits deeper, swifter, gravel-bottomed riffle areas of medium to large streams and rivers. Seems very intolerant of silt, as are most members of "saddle-back" group.

ADULT SIZE: 40-65 mm SL.

BIOLOGY: Little known. Thompson (1974. ASB Bull. 21:87) reported certain populations feed almost exclusively on snails and limpets. Spawning takes place in late winter and early spring.

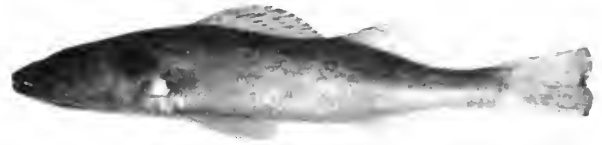
Compilers: B. A. Thompson and R. C. Cashner. May 1979.

Stizostedion canadense (Smith)
Sauger

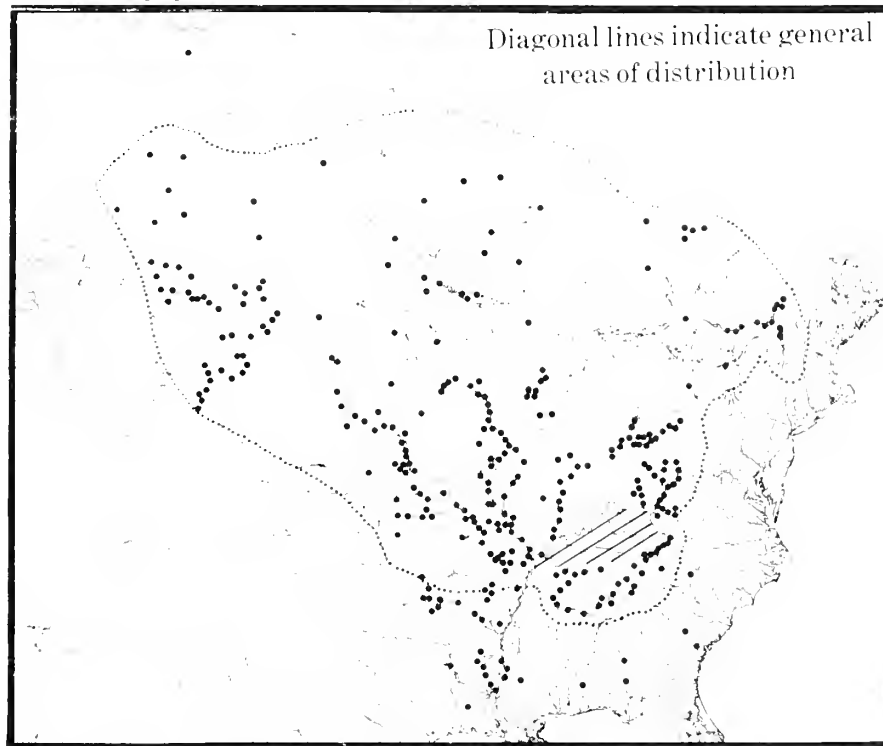
Order Perciformes
Family Percidae

TYPE LOCALITY: "Canada" (Smith in Cuvier et al. 1834. *Animal Kingdom* Vol. 10).

SYSTEMATICS: Subfamily Lucioperceinae, tribe Luciopercini (Collette 1963. *Copeia*: 615-23). Two subspecies sometimes recognized: *S. c. canadense*, more widely distributed, and *S. c. boreum* of upper Missouri River (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Hybridizes in nature with *S. vitreum* (Scott and Crossman 1973); artificial reciprocal hybrids reported by Nelson (1968. *Trans. Am. Fish. Soc.* 97:167-74). Scott and Crossman (1973) discussed inter- and intra-population variability.



IA: Clayton Co., Mississippi River at Clayton, 130 mm SL (NCSM).



Diagonal lines indicate general areas of distribution

Dotted line separates native from transplanted populations

DISTRIBUTION AND HABITAT: Native range entirely west of Appalachian mountains, but introduced into some eastern drainages. Native from QU south through Great Lakes and Mississippi Valley to AR and TN, northwest to MT. In Canada, occurs north to James Bay, west across southern ON, SA, and central AT (see Rostlund 1952. *Univ. Calif. Publ. Geogr.* 9:1-313; Scott and Crossman 1973; Hackney and Holbrook 1978. *Am. Fish. Soc. Spec. Publ.* 11:74-81, for native range). Typical of large, often turbid, free-flowing streams, lakes, rivers and impoundments. Generally tolerant of more turbid conditions than *S. vitreum*.

ADULT SIZE: 255-460 mm TL.

BIOLOGY: Ecology, biology, management, and culture aspects in Kendall (1978. *Am. Fish. Soc. Spec. Publ.* 11:1-437). Addison and Ryder (1970. *Research Information Paper [Fisheries 38]*) and Robins (1970. *Fish. Res. Board Can. Tech. Rep.* 161) gave indexed bibliographies of *Stizostedion*. Growth slower than *S. vitreum*; female growth rate exceeds male (Hassler 1957. *J. Tenn. Acad. Sci.* 32:55-76). Reproduction and early survival dependent on large river habitat (Nelson 1968. *Trans. Am. Fish. Soc.* 97:159-66). Diurnal feeder (Ali and Anctil 1968. *J. Fish. Res. Board Can.* 25:2001-03), but spawns at night over shoals of gravel to rubble in large, turbid lakes or streams (Scott and Crossman 1973). Other life history aspects similar to *S. vitreum*.

Compiler: T. Y. Barila. December 1979.

Stizostedion vitreum (Mitchill)
Walleye

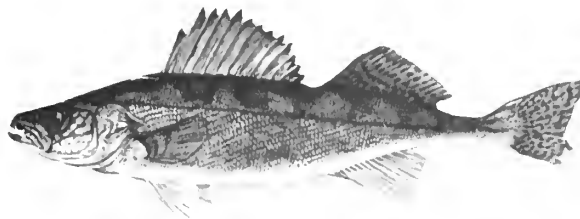
TYPE LOCALITY: Cayuga Lake, NY (Mitchill 1818. Am. Month. Mag. Crit. Rev. [Supp. 2]: 241-48).

SYSTEMATICS: Subfamily Luciopercinae, tribe Luciopercini (Collette 1963. Copeia: 615-23). Two subspecies recognized: *S. v. vitreum*, yellow walleye, and *S. v. glaucum*, blue walleye (Scott and Crossman 1973. *Freshwater Fishes of Canada*), the latter endangered (Federal Register 1975. 40 [188]: 44423). Inter-lake and genotypic variability reported (Scott and Crossman 1973; Clayton et al. 1971. J. Fish. Res. Board Can. 28: 1005-08). Both subspecies hybridize with *S. canadense* (Scott and Crossman 1973). Collette and Banareseu (1977. J. Fish. Res. Board Can. 34:1450-63) considered three Eurasian pike-perches of genus *Lucioperca* congeneric with *Stizostedion*.

DISTRIBUTION AND HABITAT: Native range believed from QU south to northern GA and AL; northwest to ND; north from Mackenzie River, Great Slave Lake, Peace River in BC to southern AT; Hudson and James Bay drainages (see Rostlund 1952. Univ. Calif. Publ. Geogr. 9:1-313; Scott and Crossman 1973; Hackney and Holbrook 1978. Am. Fish. Soc. Spec. Publ. 11:74-81, for native range). Occurrence on Atlantic and Gulf coasts generally thought result of introductions, but possibly native to certain drainages. Widely introduced within and outside this range (Carlander et al. 1978. Am. Fish. Soc. Spec. Publ. 11:27-38). Occurs in large streams, rivers, and lakes, generally in moderately deep (to 15 m) waters.

ADULT SIZE: 300-780 mm TL maximum.

Order Perciformes
Family Percidae



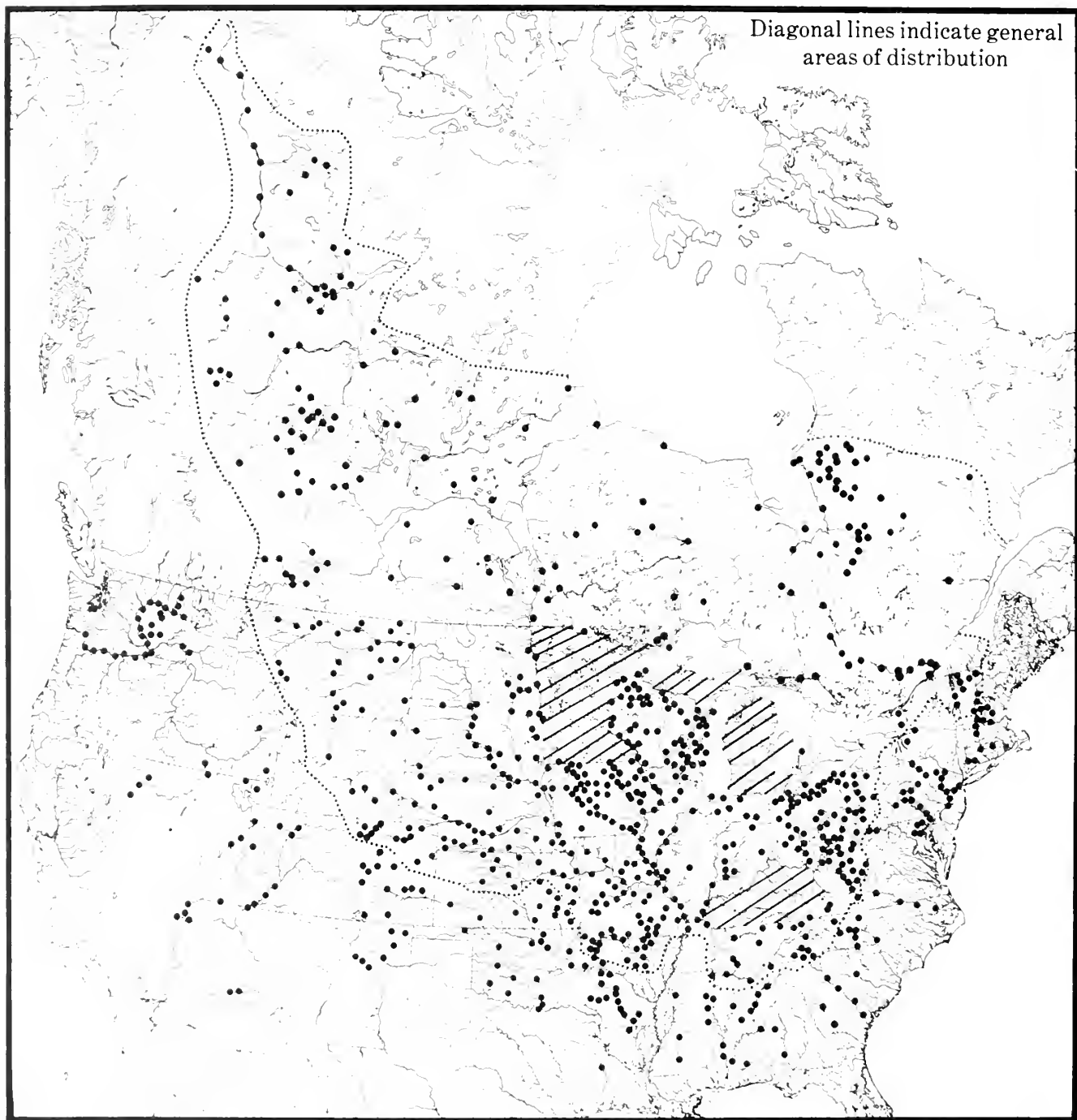
(N.C. Wildl. Resour. Comm.
and NCSM)



See map on next page

BIOLOGY: Ecology, biology, management, and culture aspects in Kendall (1978. (ed.) Am. Fish. Soc. Spec. Publ. 11: 1-437), Regier et al. (1969. Great Lakes Fish. Comm. Tech. Rep. 15:1-101), and Eschmeyer (1950. Bull. Inst. Fish Res. 3:1-99). Addison and Ryder (1970. Research Information Paper [Fisheries 38]), and Robins (1970. Fish. Res. Board Can. Tech. Rep. 161) gave indexed bibliographies of *Stizostedion*. Spawns early spring at 3-16°C (Ney 1978. Am. Fish. Soc. Spec. Publ. 11:1-12) and requires extended winter chill (10°C) for gonadal maturation (Hokanson 1977. J. Fish. Res. Board Can. 34:1524-50). Spawns in shallow gravel substrate and rubble shoals (Johnson 1961. Trans. Am. Fish. Soc. 90:312-22; Scott and Crossman 1973). Embryo and larval characteristics described by Nelson (1968. Trans. Am. Fish. Soc. 97:167-74). Food availability, fecundity, and early growth reported by Ney (1978). Diet of fry includes benthic invertebrates (Walker and Applegate 1976. Prog. Fish. Cult. 38:217-20) and fish (Maloney and Johnson 1955. Trans. Am. Fish. Soc. 85:191-202). Adults predaceous. Exhibits nocturnal behavior (Kelso 1976. J. Fish. Res. Board Can. 33:2070-72); greatest activity in spring and fall (Schupp 1972. Minn. Dept. Nat. Res. Fish Invest. Rep. 317).

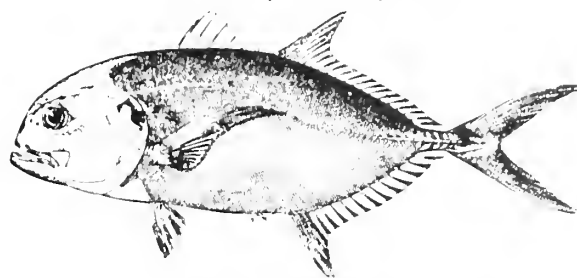
Compiler: T. Y. Barila. December 1979.



Dotted line separates native from transplanted populations

Caranx hippos (Linnaeus)
Creville jack

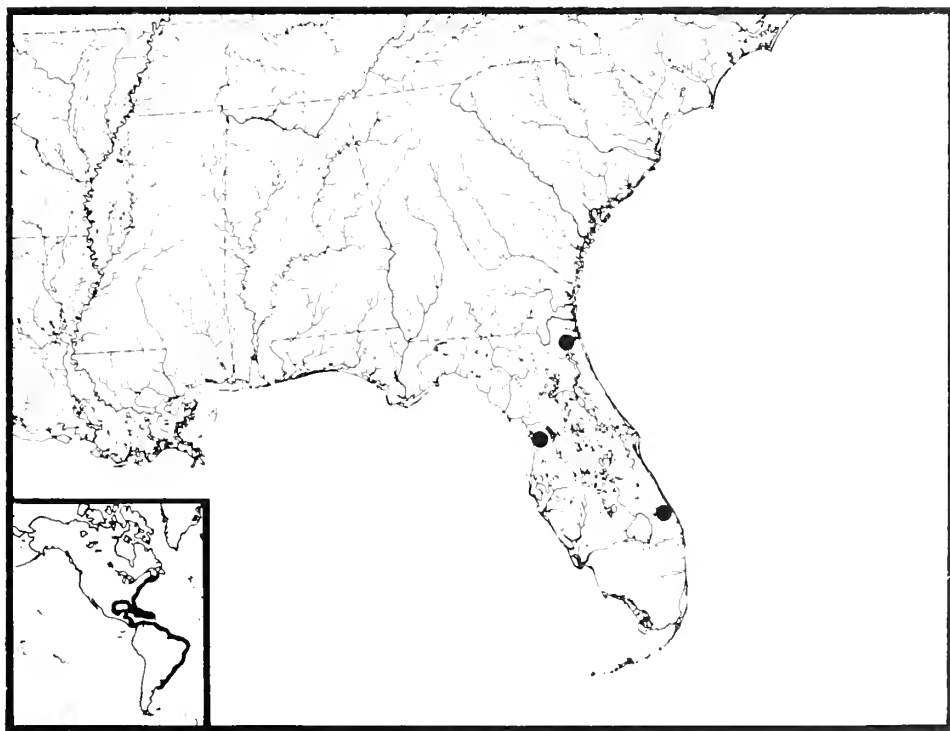
Order Perciformes
Family Carangidae



MA: Woods Hole (Jordan and
Evermann 1900).

TYPE LOCALITY: Charleston, SC (Linnaeus 1766, *Systema naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532).

SYSTEMATICS: Once regarded as circumtropical - temperate species (Berry 1959, U.S. Fish. Bull. 59:417-535.), now restricted to Western Atlantic with geminate relative in eastern Pacific and eastern Atlantic (Berry and Smith-Vaniz 1977, in Fischer [ed.] 1978, FAO Species Identification Sheets for Fishery Purposes — Western Central Atlantic [Fishing Area 31], Vol. 1). Often confused with *C. latus*.



Only freshwater localities are plotted

DISTRIBUTION AND HABITAT: Nova Scotia to Uruguay, including Gulf of Mexico and parts of Caribbean and Bahamas. Generally oceanic, but juveniles migrate to inshore brackish waters and may sometimes enter fresh water. Juveniles often found near floating debris or *Sargassum* and in grass beds. Typically schools.

ADULT SIZE: 1020 mm TL (maximum).

BIOLOGY: Spawns offshore March to September (Berry 1959). Carnivorous, mainly piscivorous. Age and growth data lacking.

Compiler: S. W. Ross, January 1980.

Lutjanus griseus (Linnaeus)
Gray snapper

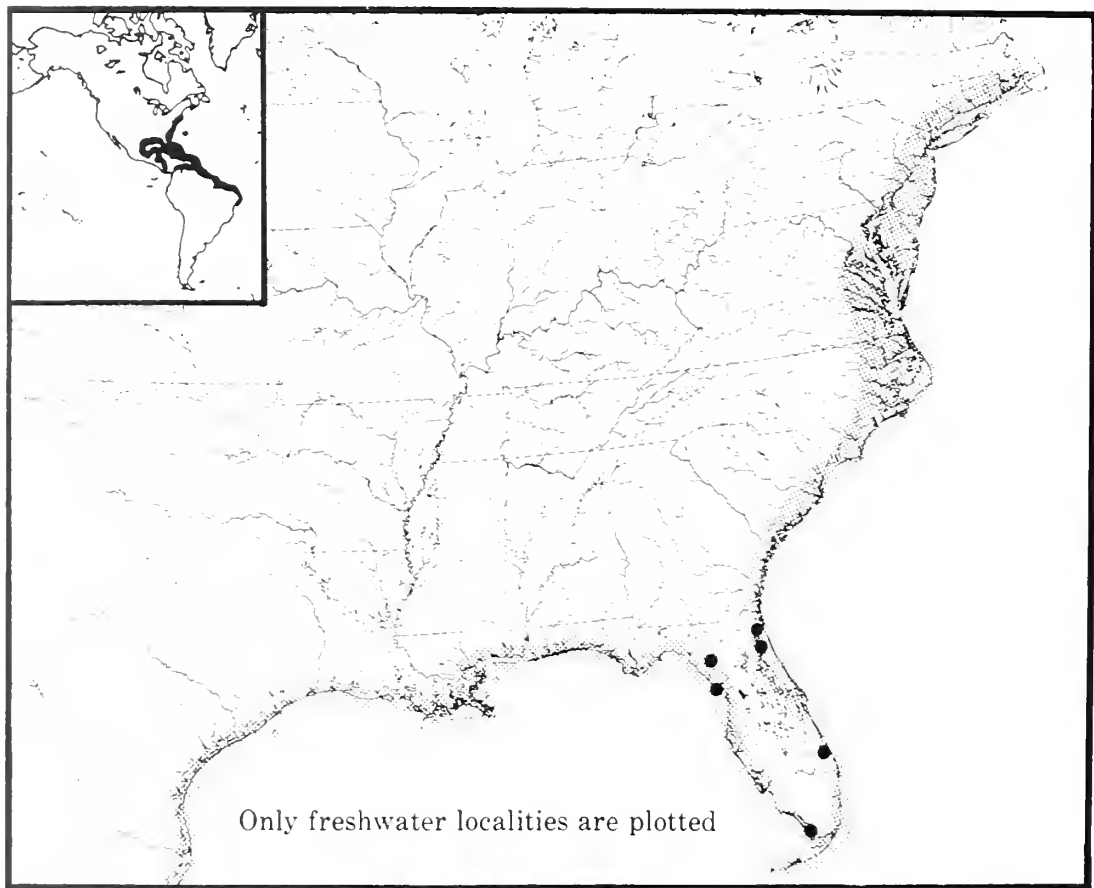
Order Perciformes
Family Lutjanidae

TYPE LOCALITY: Bahamas (Linnaeus 1758. *Systema naturae*. Laurentii Salvii. Holmiae. 10 ed., 1:1-827).

SYSTEMATICS: Member of a closely related complex of snappers that includes *L. cyanopterus*, *L. jocu*, and *L. apodus* (Rivas 1949. Copeia:150-52). *Lutjanus* is circum-tropical genus represented by the most species in the Indo-Pacific area.



FL: Gilchrist Co., Fannin Springs, 163 mm SL (NCSM)



DISTRIBUTION AND HABITAT: From MA south along United States coast through Florida Keys, and along northern Gulf of Mexico to Mexico. Most abundant in FL. Common in estuaries and often enters fresh water. Usually around inshore structures such as pilings, wrecks, reefs, mangroove roots, and grass beds, but larger adults often in channels or deeper offshore waters. Ecologically one of the most generalized snappers.

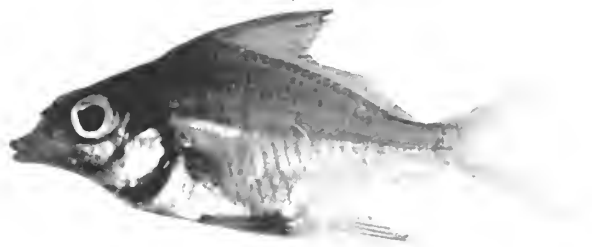
ADULT SIZE: 185-500 mm SL.

BIOLOGY: Starck and Schroeder (1970. Stud. Trop. Oceanogr. Miami 10:1-224) covered all aspects of life history, ecology, and parasitology of *L. griseus*, concentrating on Florida Keys specimens. Usually feeds at night; foods include copepods, amphipods, shrimp, crabs, and fish. First spawning at age three in summer; maximum age nine years. Randall (1967. Stud. Trop. Oceanogr. Miami 5:665-847) examined food habits of Caribbean specimens.

Compiler: S. W. Ross. December 1978.

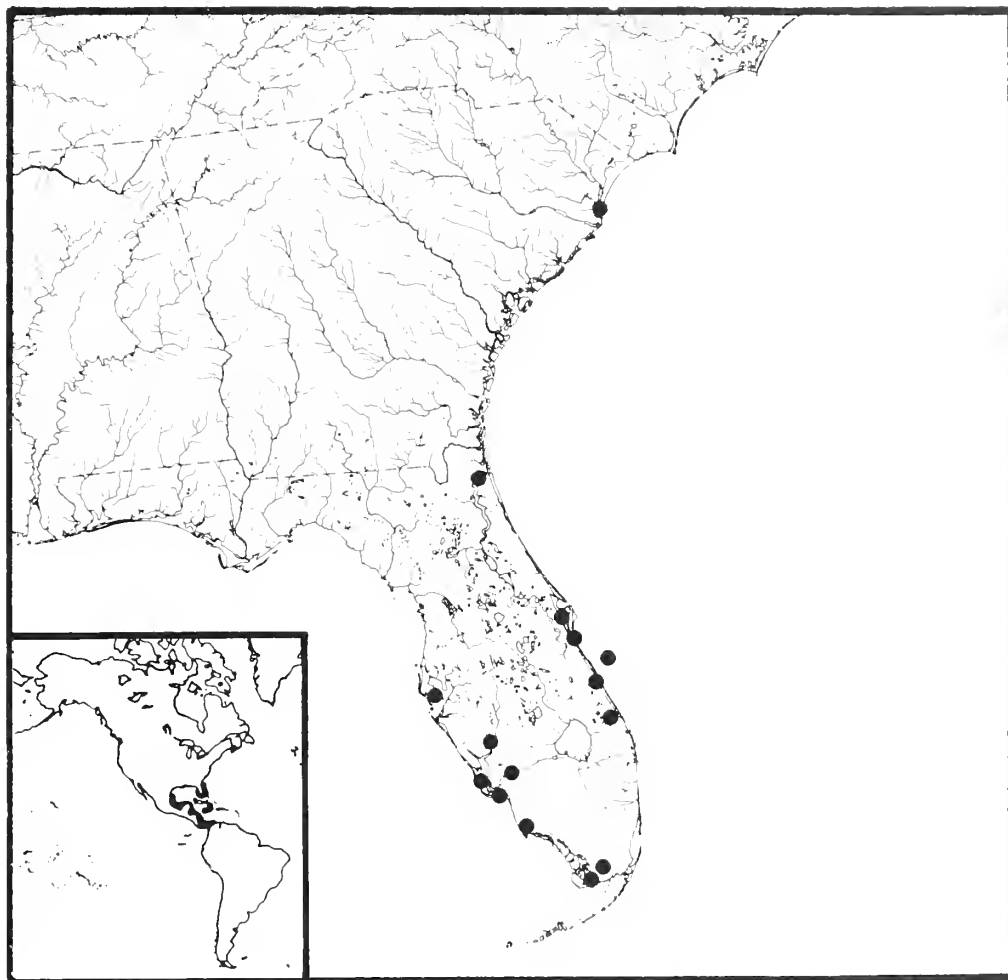
Diapterus plumieri (Valenciennes)
Striped mojarra

Order Perciformes
Family Gerreidae



FL: St. Lucie Co., Indian
River, 72 mm SL (NCSM).

TYPE LOCALITY: Puerto Rico (Valenciennes in Cuvier and Valenciennes 1830, *Histoire Naturelle des Poissons* 6:1-559).
SYSTEMATICS: Deckert (1973, M. S. thesis, Northern Illinois Univ.) preferred to separate *Eugerres* from *Diapterus* recognizing three Atlantic species (*E. brasiliensis*, *E. plumieri*, and *E. mexicanus*) and two Atlantic *Diapterus* (*D. auratus* and *D. rhombus*). The 1980 AFS checklist committee does not support this split and retain the name *Diapterus*.



DISTRIBUTION AND HABITAT: Northern coast of Columbia north to SC (Cain and Dean 1976, Mar. Biol. 36:369-79), but not reported from northern Gulf of Mexico (Deckert 1973). All reported occurrences in fresh water are from FL.

BIOLOGY: Food of three specimens consisted of polychaetes, ostracods, and copepods (Springer and Woodburn 1960, Fla. Board Conserv. Prof. Pap. Ser. 1:1-104). Fifty-four Indian River, FL, specimens (5-45 mm SL) fed mainly on planktonic copepods and mosquito larvae (Harrington and Harrington 1961, Ecology 42:646-66). Additional life history data lacking.

ADULT SIZE: ca. 265 mm SL maximum

Compiler: S. W. Ross, May 1979.

Eucinostomus argenteus Baird
Spotfin mojarra

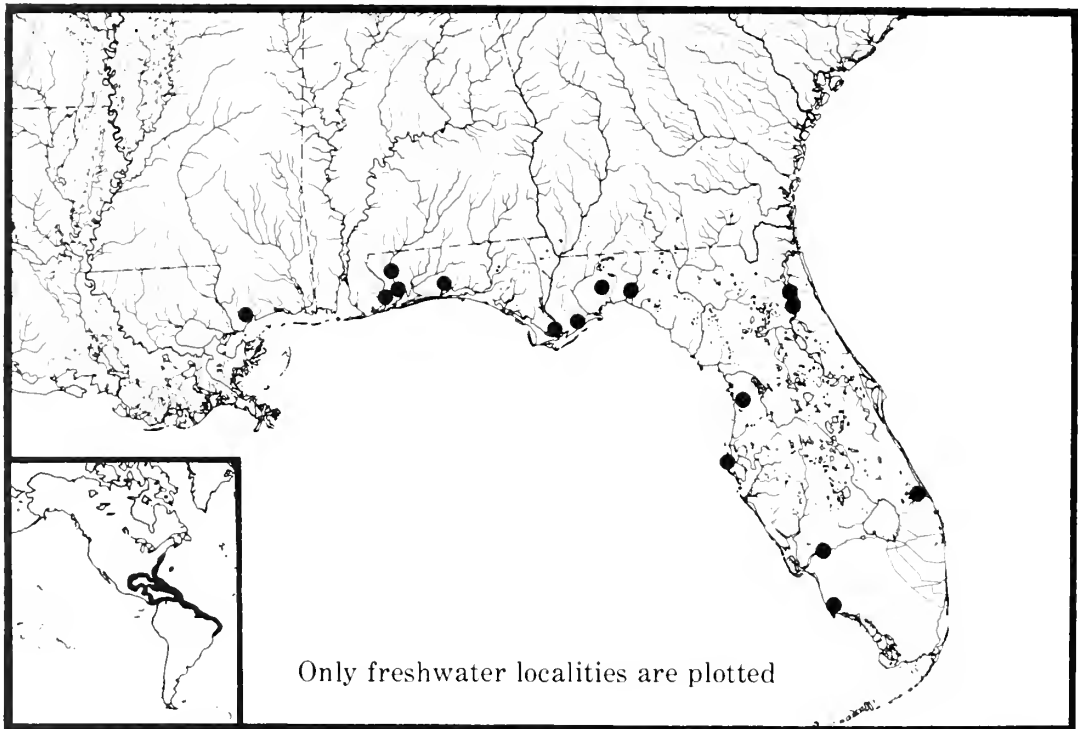
Order Perciformes
Family Gerreidae

TYPE LOCALITY: Beesley Point, NJ
(Baird 1855. Ninth Ann. Rept. Smithson.
Inst. [1854]: 317-52.

SYSTEMATICS: Most closely related to
E. jonesi; may be conspecific (C. L. Hubbs,
pers. comm.).



FL: Brevard Co., Sykes Creek,
80 mm SL (NCSM)



DISTRIBUTION AND HABITAT: Coastal and estuarine waters from NJ to Brazil, including Bermuda, Bahamas, and Caribbean, and throughout northern Gulf of Mexico. Locally common over sandy substrates from summer to late fall. Although enters fresh water, was found by Waldinger (1968. M.S. thesis, Univ. Miami) to prefer higher salinity than *E. gula* or *Diapterus plumieri*. Tabb and Manning (1961. Bull. Mar. Sci. 11:552-649) found it to prefer higher salinities in Florida Bay area. On reaching adulthood may migrate from estuaries to offshore waters (Springer and Woodburn 1960. Fla. Board Conserv. Prof. Pap. Ser. 1:1-104).

ADULT SIZE: ca. 200 mm TL maximum.

BIOLOGY: Indirect evidence suggests extended spawning with perhaps two peaks from summer through late fall (Gunter and Hall 1963. Gulf Resear. Rep. 1:189-307.). Functional morphology of swim bladder studied by Green (1964. M.S. thesis, Univ. Miami). Springer and Woodburn (1960) listed ostracods, copepods, polychaetes, pelecypods, and insect larvae as foods of Tampa Bay and St. Lucie River, FL, specimens. Randall (1963. Stud. Trop. Oceanogr. 5:666-847) reported on food of Caribbean *E. argenteus*. Life history not well known.

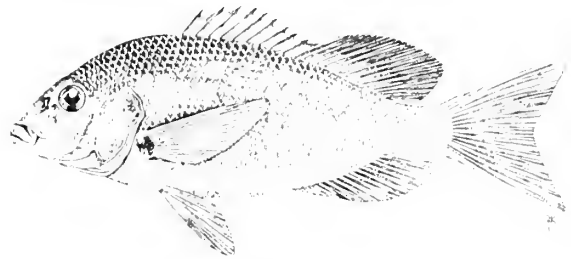
Compiler: S. W. Ross. May 1979.

Orthopristis chrysoptera (Linnaeus)
Pigfish

Order Perciformes
Family Pomadasyidae

TYPE LOCALITY: Charleston, SC (Linnaeus 1766, *Systema naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532).

SYSTEMATICS: No major treatment published. The related *O. ruber* occurs from the southern Caribbean to Brazil, and *O. brevipinnis*, *O. chalcus*, and *O. reddingi* inhabit the eastern Pacific from the Gulf of California south. The status of *O. poeyi* from Cuba is undetermined.



FL: West Atlantic, Silver Bay,
161 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Ranges from Cape Cod, MA, south to Mexico. Common to abundant south of Cape Hatteras over mud or sand bottoms, frequently in grass beds or near pilings, underwater obstructions, or rocky reefs. Usually not found in lower salinities, but reported from fresh water by Roessler (1970, Bull. Mar. Sci. 20:860-93). Ascends lower portions of St. Johns, Cape Fear, Neuse, and Potomac rivers. Genus has an antitropical distribution and tends to center in warm temperate latitudes.

ADULT SIZE: 200-300 mm SL.

BIOLOGY: Feeds primarily on shrimps, polychaetes, molluscs, and amphipods (Hildebrand and Schroeder 1928, U.S. Bur. Fish. Bull. 43:1-388; Hildebrand and Cable 1930, U.S. Bur. Fish. Bull. 46:383-488; Carr and Adams 1973, Trans. Am. Fish. Soc. 102:511-40). Spring spawning occurs in the early evening in estuaries and bays (Hildebrand and Cable 1930). Hildebrand and Cable (1930) described early development and growth (reiterated in Johnson 1978, *Development of Fishes of the Mid-Atlantic Bight* Vol. 4). Prized as a food fish in some circles.

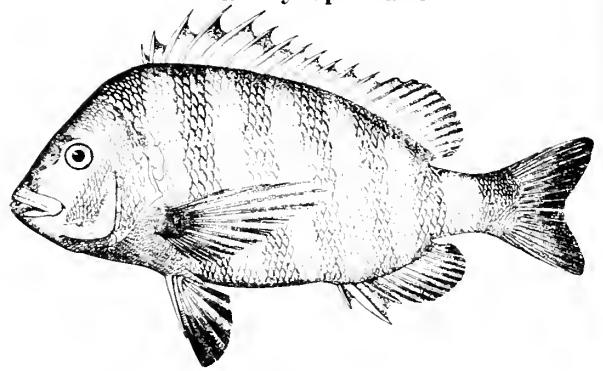
Compiler: G. H. Burgess, June 1979.

Archosargus probatocephalus
(Walbaum)
Sheepshead

Order Perciformes
Family Sparidae

TYPE LOCALITY: New York (Walbaum in Artedi 1792. *Genera Piscium* 3:4-723).

SYSTEMATICS: Caldwell (1958. Q. J. Fla. Acad. Sci. 21:138-44; 1965. Bull. South. Calif. Acad. Sci. 64:89-100) studied systematics and variation, and recognized three subspecies, *A. p. probatocephalus*, *A. p. aries*, and *A. p. oriceps*. The last was considered a full species by Ginsburg (1952. J. Wash. Acad. Sci. 42:84-101).



NC: Carteret Co., Beaufort
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Ranges from Shelbourne Harbor, NS (Gilhen et al. 1976. Can. Field-Nat. 90:42-46) to near Rio de Janeiro, Brazil. (*A. p. probatocephalus*: NS to Cedar Key, FL; *A. p. oriceps*: St. Marks, FL, to Campeche Bank, Mexico; *A. p. aries*: Belize to Brazil) (Caldwell 1965). A continental species that does not occur on Caribbean islands. Common south of Cape Hatteras (formerly more common north to Cape Cod). Adults frequent rocky reefs and jetties, wrecks, oyster beds, and pilings; juveniles are found in grass beds over mud bottom. Not uncommon in low salinity situations, but rare in pure fresh water. Reported from FL fresh waters by Herald and Strickland (1949. Q. J. Fla. Acad. Sci. 11:99-109) and Tagatz (1968. Q. J. Fla. Acad. Sci. 30:25-50). Does not school, but often forms loose feeding aggregations.

ADULT SIZE: ca. 300-600 mm TL, ca. 900 mm TL maximum.

BIOLOGY: Spring spawning probably occurs offshore (Hildebrand and Cable 1938. U.S. Bur. Fish. Bull. 24:505-642; Springer and Woodburn 1960. Fla. Board Conserv. Mar. Res. Lab. Prof. Pap. Ser. 1:1-104). Early development described by Hildebrand and Cable (1938) and Mook (1977. Copeia: 126-33), summarized in Johnson (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 4). Feeds on mollusks, crustaceans, barnacles, and plant material (Hildebrand and Schroeder 1928. U. S. Bur. Fish. Bull. 43:1-388; Hildebrand and Cable 1938; Gunter 1945. Publ. Inst. Mar. Sci. Univ. Tex. 1:1-190; Darnell 1959. Publ. Inst. Mar. Sci. Univ. Tex. 5:353-416; Springer and Woodburn 1960). A popular game and food fish.

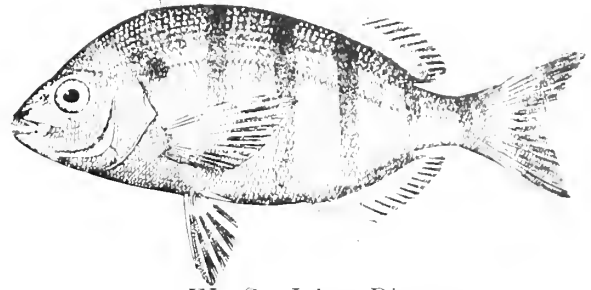
Compiler: G. H. Burgess. June 1979.

Lagodon rhomboides (Linnaeus)
Pinfish

Order Perciformes
Family Sparidae

TYPE LOCALITY: Charleston, SC (Linnaeus 1766. *Systema naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532.)

SYSTEMATICS: Monotypic. Relationships within Sparidae uncertain. Caldwell (1957. Bull. Fla. State Mus. Biol. Sci. 2:77-173) discussed systematics and variation.



FL: St. Johns River, ca.
16 cm SL (Jordan and
Evermann 1900).



DISTRIBUTION AND HABITAT: Ranges from Cape Cod, MA, to Yucatan Peninsula, Mexico; most common south of Cape Hatteras, NC. A continental form that does not inhabit insular situations, except in Bermuda, where a permanent population exists. An abundant and ubiquitous species that prefers areas with attached aquatic vegetation, but also frequents other habitats offering some degree of cover (eg., rocky reefs, jetties, pilings). Widely euryhaline (0-43.8 ppt) and eurythermal (7-37.9°C) (Roessler 1970. Bull. Mar. Sci. 20:860-93). Reported from FL fresh waters by Tagatz (1968. Q. J. Fla. Acad. Sci. 30:25-50) and Roessler (1970), but occurs much more frequently in estuarine and oceanic salinities.

ADULT SIZE: 100-200 mm SL, ca. 300 mm FL maximum.

BIOLOGY: Caldwell (1957) studied biology and ecology, and summarized early literature. Subsequent studies include discussions

of underwater sound (Caldwell and Caldwell 1967. Bull. South. Calif. Acad. Sci. 66:69-75); growth, respiratory metabolism, and seasonality of juveniles (Cameron 1969. Contrib. Mar. Sci. Univ. Tex. 14:19-36); role of Ca⁺ in fresh water survival (Carrier and Evans 1976. J. Exp. Biol. 65:529-38); food habits (Darnell 1959. Publ. Inst. Mar. Sci. Univ. Tex. 5:353-416); food, growth, migration, reproduction, and abundance (Hansen 1968. U.S. Fish. Bull. 68:135-46); energy requirements of a population (Hoss 1974. Ecology 55:848-55); food and growth of postlarvae (Kjelson and Johnson 1976. U.S. Fish. Bull. 74:423-32; Peters et al. in Esch and McFarlane [eds.] 1976. Thermal Ecology II: 106-12); and food habits of juveniles (Carr and Adams 1972. U.S. Fish. Bull. 70:1111-20). An omnivore that favors algae, bottom invertebrates, and small fishes. Spawns offshore (October-March).

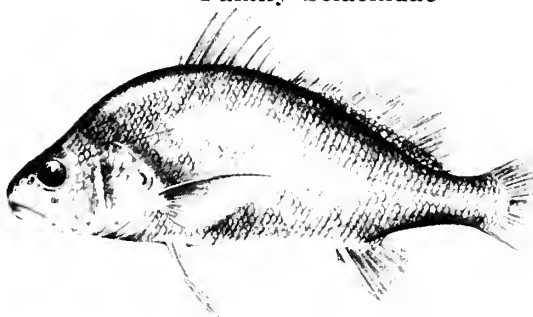
Compiler: G. H. Burgess. June 1979.

***Aplodinotus grunniens* Rafinesque**
Freshwater drum

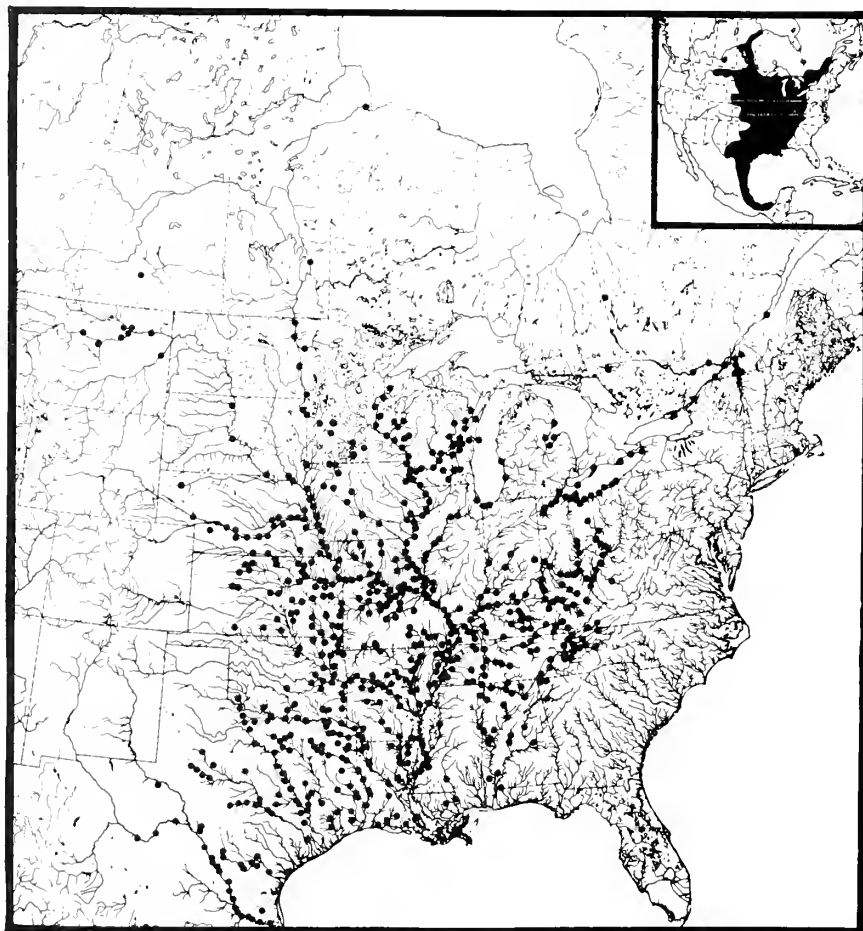
Order Perciformes
Family Sciaenidae

TYPE LOCALITY: Ohio River (Rafinesque 1819. *J. Phys. Chim. Hist. Nat. Arts* 88:417-29).

SYSTEMATICS: Monotypic genus. Only North American freshwater representative of large marine and estuarine family (Chao 1978. NOAA Tech. Rep. NMFS Circ. 415:1-64).



(NMC)



DISTRIBUTION AND HABITAT: Apparently has greatest latitudinal range of any North American freshwater fish. Ranges over much of United States east of Rocky Mountains, north to Hudson Bay and south through eastern Mexico to Rio Usumacinta system of Guatemala. Unknown from Atlantic slope proper south of St. Lawrence drainage. Seems to prefer large, silty lakes and rivers, but occurs in wide variety of habitats.

ADULT SIZE: Commonly 2 kg; may reach 18 kg.

BIOLOGY: Primarily bottom feeder, on insect larvae, crustaceans, fish, clams, and snails. Molluscs are crushed with large pads of molar-like pharyngeal teeth. Spawning occurs at water temperatures of 19-22°C, with 3.6-kg females laying about 600,000 eggs. Eggs and fry planktonic. Sexually mature male produces sound by vibrating special drumming muscles against gas bladder. Additional information summarized in Daiber (1950. Ph.D. diss., Ohio State Univ.; 1953. *Am. Midl. Nat.* 50:159-71), Priegel (1967. *The Freshwater Drum*), Scott and Crossman (1973. *Freshwater Fishes of Canada*), and Fremling (1979. *Biology and Functional Anatomy of the Freshwater Drum, Aplodinotus grunniens*).

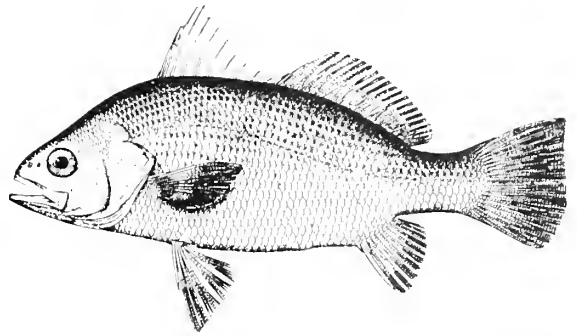
Compiler: C. R. Fremling. March 1979.

Bairdiella chrysoura (Lacepede)
Silver perch

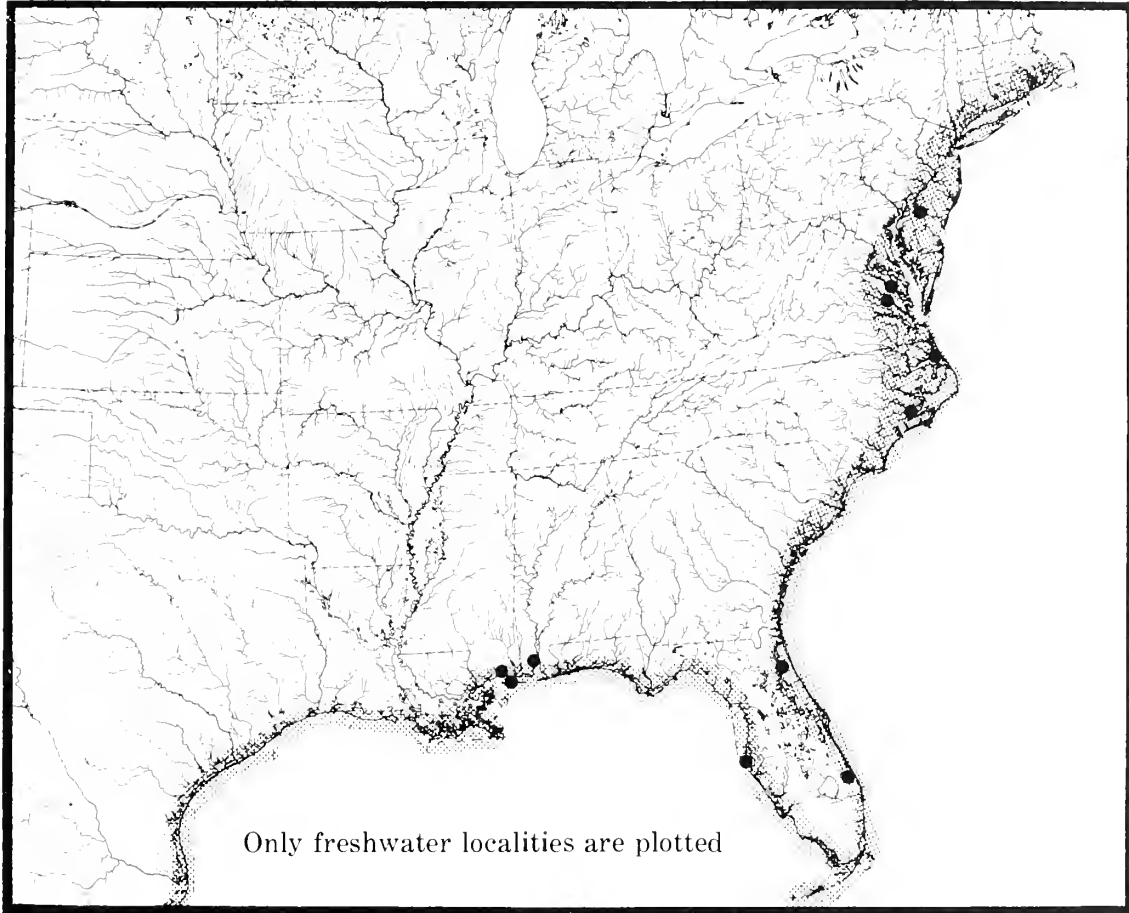
Order Perciformes
Family Sciaenidae

TYPE LOCALITY: South Carolina (Lacepede 1802. *Histoire Naturelle des Poissons* 4:1-728).

SYSTEMATICS: Chao (1976. Ph.D. diss., William and Mary College) placed *Bairdiella* in suprageneric group called the *Stellifer* group. Most closely related genera are *Odontoscion*, *Ophioscion*, and *Stellifer*. Chao (1978. NOAA Tech. Rept. NMFS Circ. 415: 1-64) reviewed Western Atlantic genera.



ca. 23 cm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: From MA to FL, and throughout northern Gulf of Mexico from FL to Mexico. Common in estuaries and nearshore marine environments. Reported from fresh water (Massman 1954. *Ecology* 35:75-78; Tagatz 1968. *Q. J. Fla. Acad. Sci.* 30:25-50; Wang and Raney 1971. *Distribution and Fluctuations in the fish fauna of the Charlotte Harbor Estuary, FL*: 1-56 p.). Young mostly found in estuaries often in grass beds.

ADULT SIZE: 130-240 mm SL.

BIOLOGY: Crustaceans seem to be most important foods, but annelids and fish may be eaten (Thomas 1971. *Ichthyological Associates Bull.* 3:1-247). Extended spawning season from late spring through summer, with time of peak spawning variable with locality. Kuntz (1914. *Bull. U.S. Bur. Fish.* 33 [1913], *Bur. Fish. Doc.* 795:1-19) reported embryology and larval development. Maximum age six years. Reviews of life history data and additional information provided by Springer and Woodburn (1960. *An Ecological Study of the Fishes of Tampa Bay Area*: 1-104) and Thomas (1971).

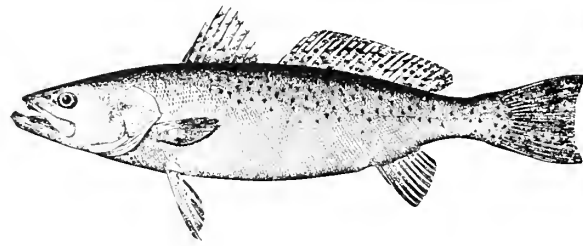
Compiler: S. W. Ross. December 1978.

Cynoscion nebulosus (Cuvier)
Spotted seatrout

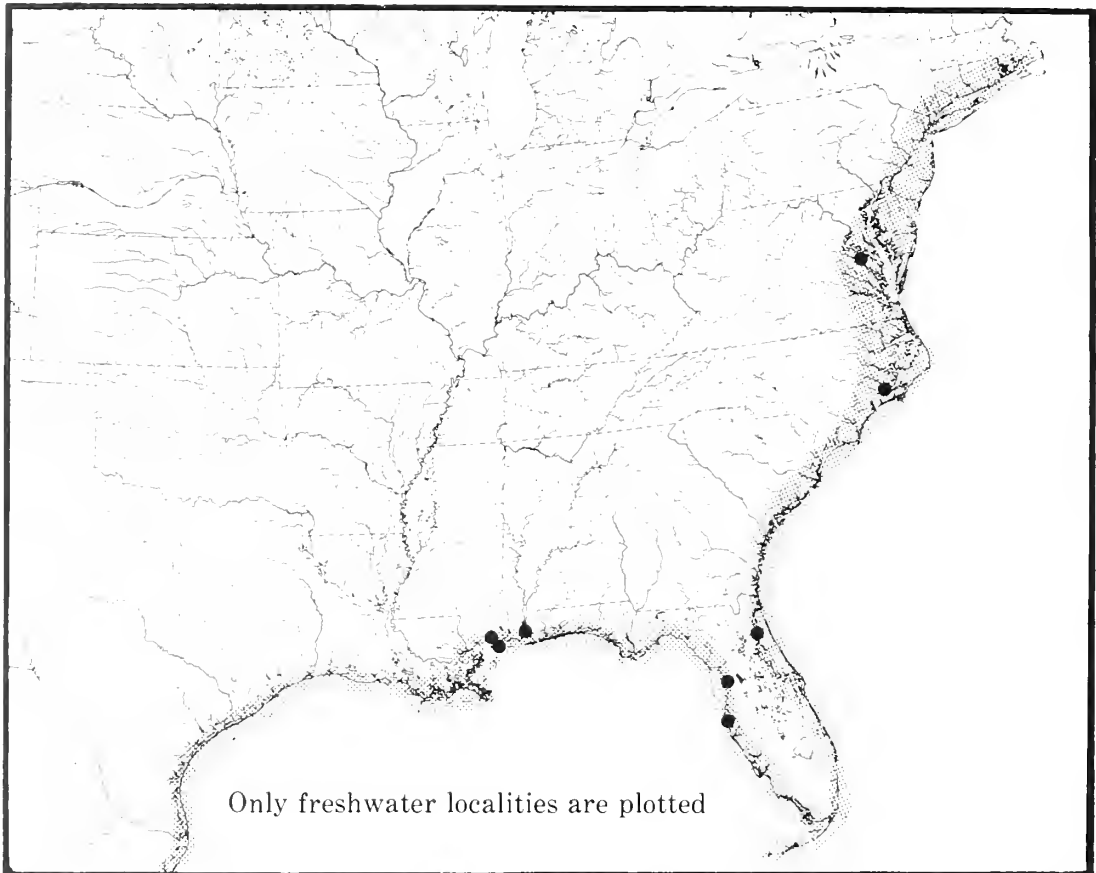
Order Perciformes
Family Sciaenidae

TYPE LOCALITY: Not given (Cuvier in Cuvier and Valenciennes 1830. *Histoire Naturelle des Poissons* 5).

SYSTEMATICS: Belongs to suprageneric *Cynoscion* group with *Isopisthus*, *Macrodon*, and *Plagioscion* (Chao 1978. NOAA Tech. Rept. NMFS Circ. 415:1-64). Although *C. nebulosus* is probably more closely related to *C. arenarius* than other *Cynoscion* (Mohsin 1973. Ph.D. diss., Texas A & M Univ.), electrophoretic data suggest that *C. nebulosus* is most divergent of four currently recognized *Cynoscion* of eastern United States and Gulf Coasts (Weinstein and Yerger 1976. Fish. Bull. 74:599-607).



(Jordan and Evermann 1900)



DISTRIBUTION AND HABITAT: From NY to northern Mexico. Coastal, euryhaline species with center of abundance in northern Gulf of Mexico and FL (Pearson 1929. Bull. U.S. Bur. Fish. [1928] 1046: 129-214). Reported from fresh water (Tagatz 1968. Q. J. Fla. Acad. Sci. 30:25-50; Massman 1954. Ecology 35:75-78). Young often in estuaries and around grass beds. Sometimes associated with hard substrate areas and at various times may form large schools. Adults in winter may move to deeper channels or offshore waters.

ADULT SIZE: 250-1250 mm TL.

BIOLOGY: Guest and Gunter (1958. Gulf States Mar. Fish. Comm. Tech. Summ. 1: 1-40) reviewed life history and habits, indicating prolonged late spring through early fall spawning. Welsh and Breder (1923. Bull. U.S. Bur. Fish. 39:141-201) and Hildebrand and Schroeder (1928. Bull. U.S. Bur. Fish. 43:1-366) also reported life history and fisheries data. Seems to be mostly piscivorous, especially at larger sizes, but also feeds on shrimp and crabs. Valuable as commercial and sport fish throughout much of range.

Compiler: S. W. Ross. December 1978.

Leiostomus xanthurus Lacepede
Spot

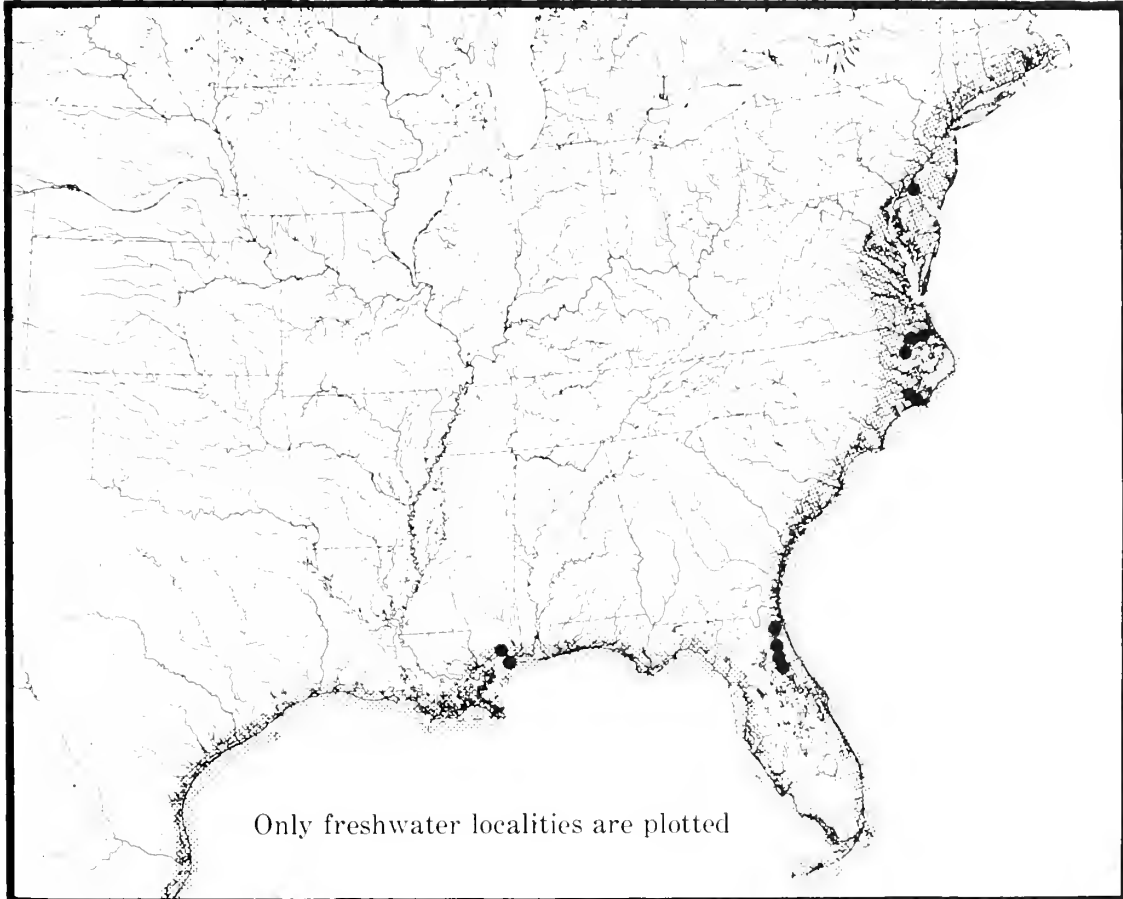
Order Perciformes
Family Sciaenidae

TYPE LOCALITY: Carolina (Lacepede 1802. *Histoire Naturelle des Poissons* 4:1-728).

SYSTEMATICS: Monotypic genus restricted to western North Atlantic Ocean. Chao (1978. NOAA Tech. Rept. NMFS Circ. 415:1-64) considered *Leiostomus* as separate group most closely allied to *Sciaena* group.



RI: Newport, ca. 16 cm SL
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: From MA through FL and northern Gulf of Mexico to Rio Grande. Juveniles especially abundant in estuaries throughout year, and adults often migrate offshore to spawn in late fall and winter. Reported from fresh water by Massman (1954. *Ecology* 35:75-78), Raney and Massman (1953. *J. Wash. Acad. Sci.* 43:424-32), Tagatz (1968. *Q. J. Fla. Acad. Sci.* 30:25-50), and Wang and Raney (1971. *Distribution and Fluctuations in the Fish Fauna of the Charlotte Harbor Estuary, FL*). Prefers mud or sand bottoms.

BIOLOGY: Benthic feeder, ingesting mostly small crustaceans, polychaetes, and detritus (Thomas 1971. *Ichthyological Associates Bull.* 3:1-247). Extended spawning (predominantly offshore) from late fall through winter. Age, growth, and other life history aspects reported by Chao and Musick (1977. *Fish. Bull.* 75:657-702), Dawson (1958. *Contr. Bears Bluff Lab.* 28:1-48), Pacheco (1962. *Chesapeake Sci.* 3:18-28), Powles and Stender (1978. *S.C. Mar. Res. Cent. Tech. Rept.* 31:1-64), and Sundararaj (1960. *Tulane Stud. Zool.* 8:41-62). Commercially important food fish, particularly in Carolinas and Chesapeake Bay region.

ADULT SIZE: 360 mm TL maximum.

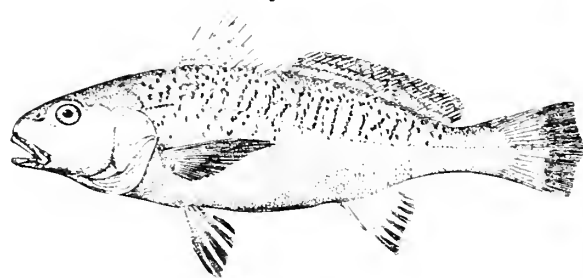
Compiler: S. W. Ross. January 1979.

Micropogonias undulatus (Linnaeus)
Atlantic croaker

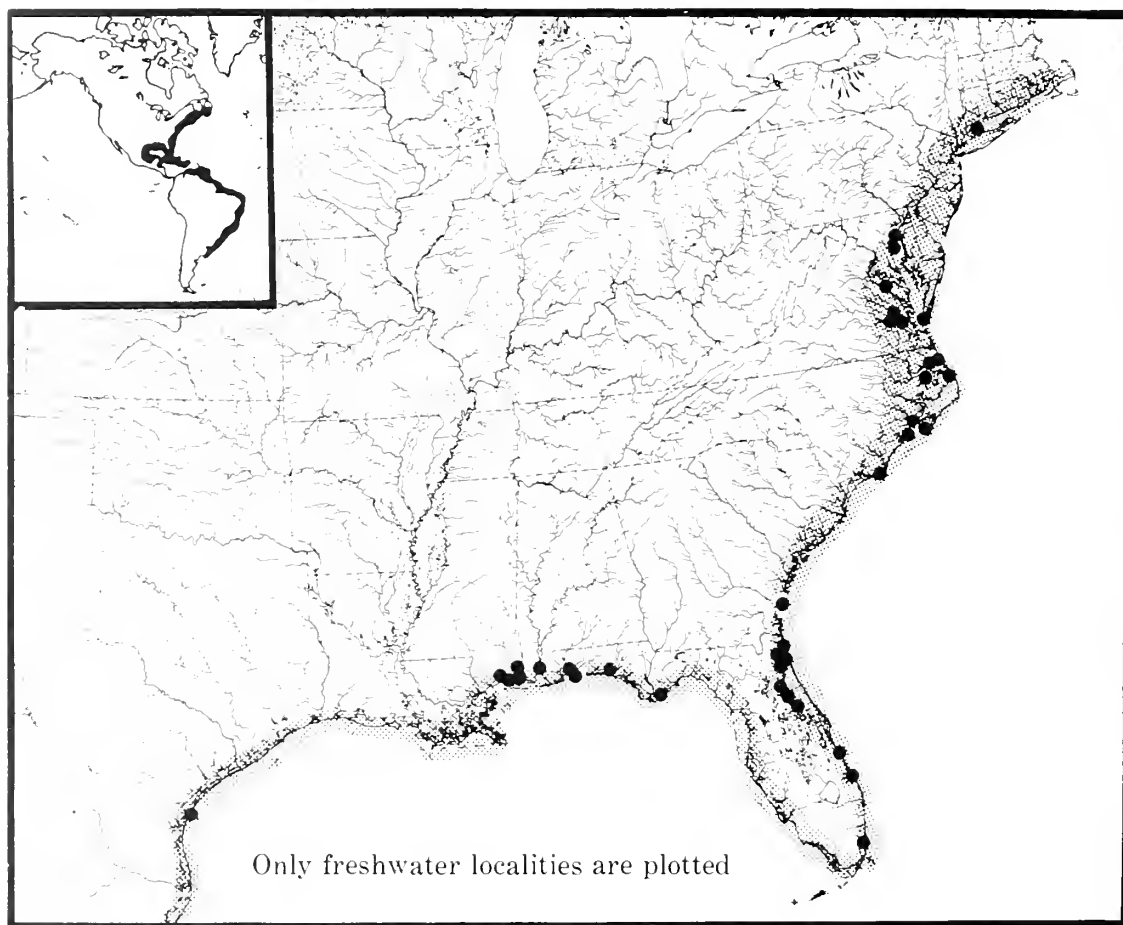
Order Perciformes
Family Sciaenidae

TYPE LOCALITY: South Carolina (Linnaeus 1766, *Systema naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532).

SYSTEMATICS: Chao (1978, NOAA Tech. Rept. NMFS Circ. 415:1-64) resumed the use of the valid generic name *Micropogonias*. Only other member of this genus in the western Atlantic is *M. furneri*, a Caribbean and South American species.



RI: Newport, ca. 27 cm SL
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Coastal distribution from MA through FL and the northern Gulf of Mexico to Mexico. Generally abundant but may undergo large yearly fluctuations in population size. Juveniles are more estuarine restricted whereas adults move offshore to spawn. Demersal species preferring sand or mud bottoms. Known to enter freshwater.

ADULT SIZE: 668 mm TL maximum.

BIOLOGY: Benthic feeder consuming mostly crustaceans and polychaetes. Extended spawning season from late fall through winter. Rarely lives longer than four years (Thomas 1971, Ichthyological Associates, Bull. 3:1-247). Chao and Musick (1977, Fish. Bull. 75:657-702) reviewed literature and presented data on early life history of croaker in the York River, VA. Commercially and recreationally valuable.

Compiler: S. W. Ross, January 1979.

Sciaenops ocellata (Linnaeus)
Red drum

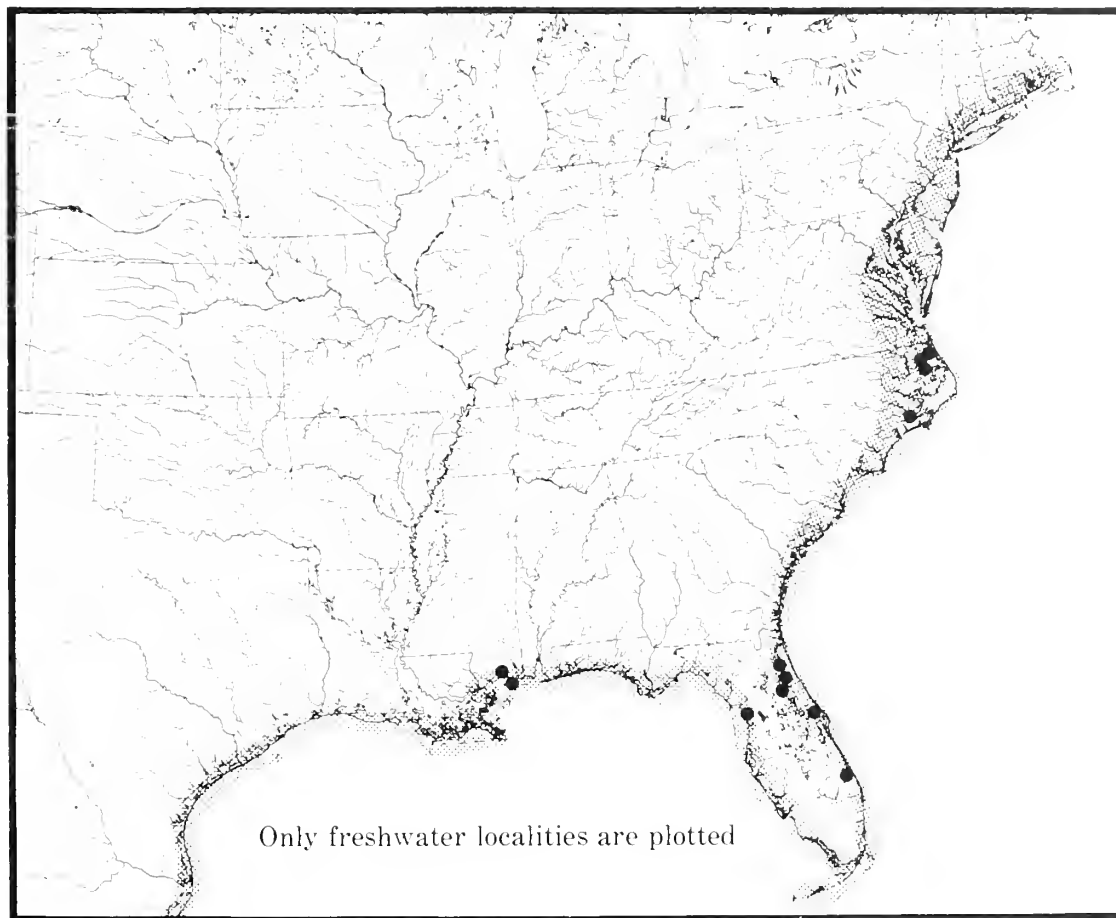
Order Perciformes
Family Sciaenidae

TYPE LOCALITY: South Carolina (Linnaeus 1766, *Systema naturae*, Laurentii Salvii, Holmiae, 12 ed., 1:1-532).

SYSTEMATICS: Monotypic genus placed in separate group by Chao (1978, NOAA Tech. Rept. NMFS Circ. 415:1-64).



TX: Indianola, ca. 26 cm SL
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Common from Mexico through FL to Chesapeake Bay with occasional strays to MA. Juveniles use estuaries as nursery areas and adults migrate into nearshore coastal waters to spawn. Most common over sandy bottoms and often captured in surf zone. Rarely enters fresh water, but Tagatz (1968, Q. J. Fla. Acad. Sci. 30:25-50) reported it from St. Johns River, FL.

ADULT SIZE: 1550 mm TL maximum.

BIOLOGY: Juveniles eat mostly crustaceans but tend to become more piscivorous as they mature (Bass and Avault 1975, Trans. Am. Fish. Soc. 104:35-45; Pearson 1929, Bur. Fish. Bull. 64:178-94). Coastal spawning from early fall through early winter. Powles and Stender (1978, S.C. Mar. Res. Cent. Tech. Rept. 31:1-64) presented data and literature review of early life history. Pearson (1929) and Simmons and Breuer (1962, Inst. Mar. Sci. Univ. Tex. 8:184-211) reported additional life history data. Considered valuable to recreational fishery.

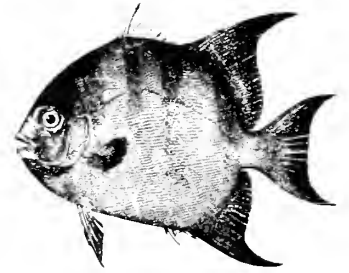
Compiler: S. W. Ross, February 1979.

Chaetodipterus faber (Broussonet)
Atlantic spadefish

Order Perciformes
Family Ephippidae

TYPE LOCALITY: Jamaica (Broussonet 1782. Ichthy. Sist. Pisc. Vol. 5).

SYSTEMATICS: Subfamily Ephippinae. Closely related to Pacific *C. zonatus*, which ranges from San Diego, CA, south.



United States: east coast,
ca. 15.5 cm SL (Jordan and
Evermann 1900).



DISTRIBUTION AND HABITAT: Recorded from Woods Hole, MA to Santos, Brazil, including Caribbean islands and Bahamas; introduced in Bermuda. Most common from lower Chesapeake Bay south. Juveniles frequent estuarine (rarely fresh-water) channels and grass flats; adults most often school around rock and coral reefs, pilings, and wrecks in more saline (and offshore) waters. Reported from fresh water by Anderson (1964, Copeia:242-44) and Tagatz (1968, Q. J. Fla. Acad. Sci. 30: 25-50), and from 128 km upstream at Gunston Wharf in Potomac River, VA (Smith and Bean 1899, Bull. U.S. Fish Comm. 18:179-87).

ADULT SIZE: ca. 135-600 mm SL, ca. 900 mm SL maximum.

BIOLOGY: Feeds on bottom invertebrates and vegetation (Hildebrand and Schroeder 1928, Bull. U.S. Bur. Fish. 43:1-366; Randall 1967, Stud. Trop. Oceanogr. 5:665-847). Spawning occurs offshore during spring and summer; Chapman (1978, Copeia:336) observed spawning behavior. Early development described by Ryder (1887, Rept. U.S. Fish Comm. 13:488-604) and Hildebrand and Cable (1938, Bull. U.S. Bur. Fish. 48: 505-642), summarized in Johnson (1978, *Development of Fishes of the Mid-Atlantic Bight* Vol. 4).

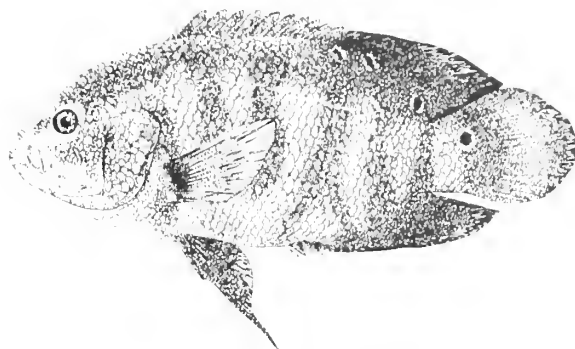
Compiler: G. H. Burgess, June 1979.

Astronotus ocellatus (Cuvier)
Oscar

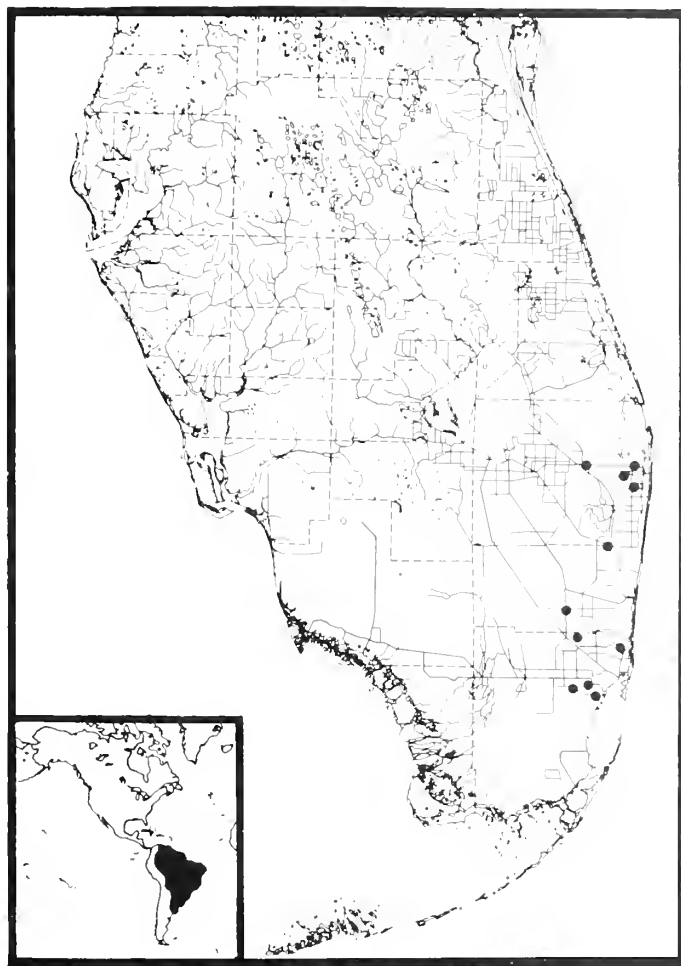
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Atlantic Ocean; erroneous, probably Brazil (Cuvier in Spix and Agassiz 1831, *Selecta genera et species piscium quos in itinere par Brasiliam*, . . . 1-138).

SYSTEMATICS: Genus apparently includes a second species, *A. orbiculatus* (Goldstein 1973, *Cichlids of the World*). Included in key to FL freshwater fishes by Stevenson (1976, *Vertebrates of Florida*).



FL: Dade Co. (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Amazon, Parana, Rio Paraguay, and Rio Negro. Established in canals and ponds in Dade, Broward, and Palm Beach cos., FL. Has been collected in PA, MA, ME, and RI. Population densities in FL are low. Introductions due to intentional release from a fish farm and releases of aquarium fish.

ADULT SIZE: In native range 200-280 mm TL, 330 mm SL maximum.

BIOLOGY: Carnivorous. Eggs are laid on substrate, and parents incubate eggs and guard young. In FL spawning occurs during June-October at 28-33°C. Literature on spawning summarized by Breder and Rosen (1966, *Modes of Reproduction in Fishes*). Behavior studied by Baerends and Baerends-Van Roon (1950, *Behaviour*, Suppl. 1:1-243).

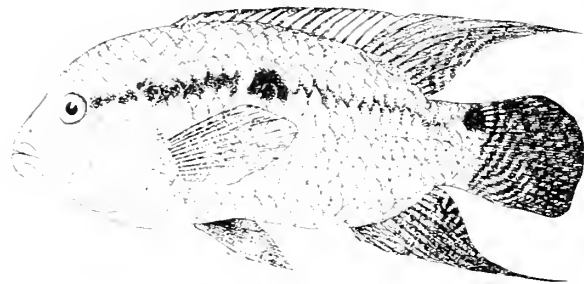
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Cichlasoma bimaculatum (Linnaeus)
Black acara

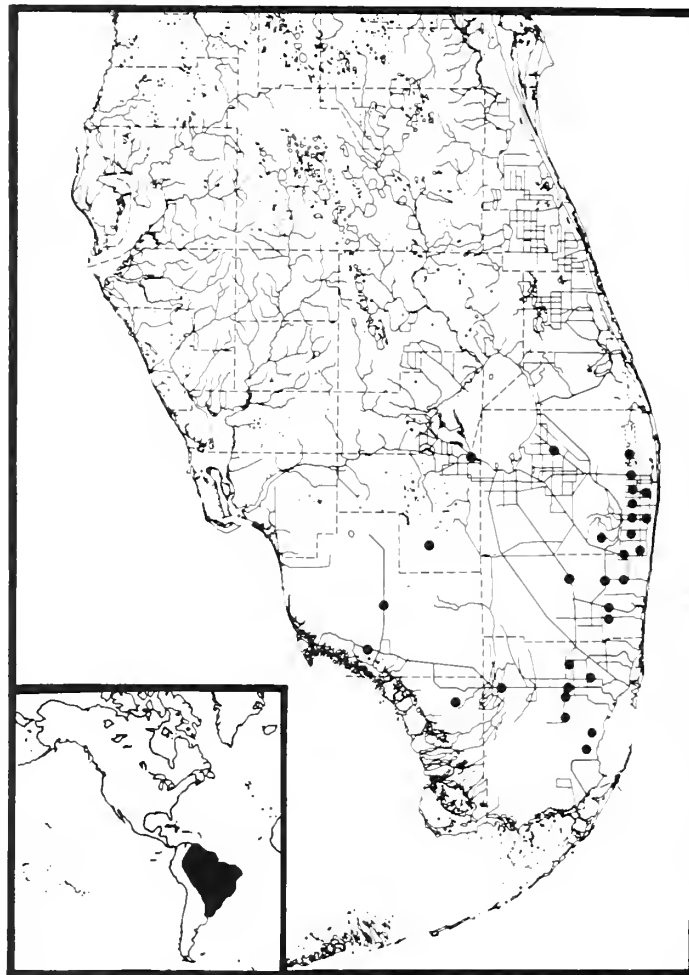
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Mediterranean Sea; erroneous, probably Brazil (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Last major revision was that of Regan (1905. *Ann. Mag. Nat. Hist.* [Ser. 7] 16:60-77, 225-43, 316-40, 433-45). Placed in subgenus and section *Cichlasoma*. Included in key to freshwater fishes of FL by Stevenson (1976. *Vertebrates of Florida*).



FL: Broward Co. (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Creeks and lakes in Brazil, Surinam, Guyana, French Guyana, southern and eastern Venezuela, and Trinidad. Established in canals and swamps in Broward, Dade, Monroe, Palm Beach, Hendry, and Collier cos., FL. Possibly competes with native centrarchids for spawning sites. Appears to have low salinity tolerance. Able to tolerate low oxygen levels; possibly has stomach modified as accessory respiratory organ. Dominant fish at some FL localities. Introduction due to escapes or intentional releases from fish farms.

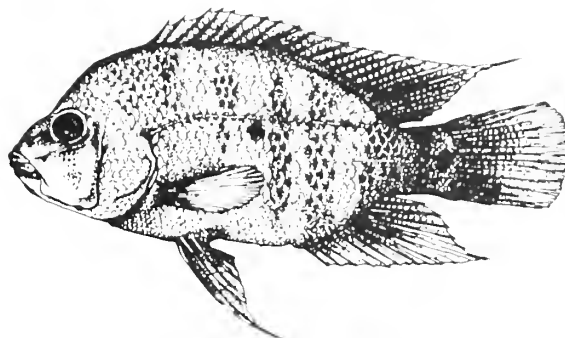
ADULT SIZE: In United States 110-130 mm SL, 200 mm SL maximum.

BIOLOGY: Omnivorous. Eggs are laid on hard substrate, and parents incubate eggs and guard young. Spawns throughout year in FL with peaks of activity in spring and fall. Behavior studied by Baerends and Baerends-Van Roon (1950. *Behaviour*, Suppl. 1:1-243). Information on growth, reproduction, feeding, and habitat preferences in native range presented by Lowe-McConnell (1964. *J. Linn. Soc. Lond.* [Zool.] 45:103-44; and 1969. *J. Linn. Soc. Lond.* [Zool.] 48:255-302).

Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

***Cichlasoma cyanoguttatum* (Baird and Girard)**
Rio Grande perch

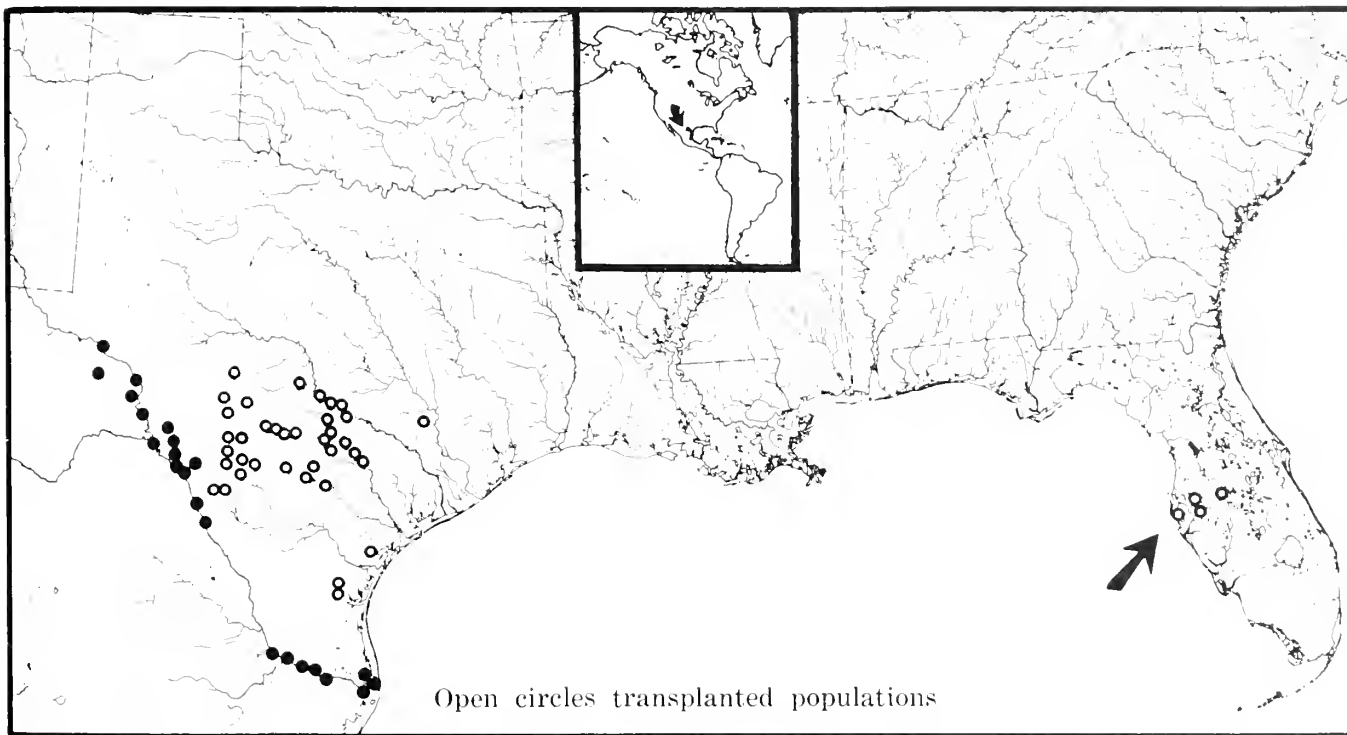
Order Perciformes
 Family Cichlidae



TX: Bexar Co., Braunig Lake,
 125 mm SL (F. Birkhead).

TYPE LOCALITY: Rio Grande, Brownsville, TX (Baird and Girard 1854. Proc. Acad. Nat. Sci. Phila. [1854-1855] 7:24-25).

SYSTEMATICS: United States populations, the northernmost representative of neotropical family Cichlidae, referable to nominate subspecies *C. c. cyanoguttatum*. Other subspecies occur in northeastern Mexico (Alvarez 1970. *Peces Mexicanos*). Several trophic morphs occur in Cuatro Ciénegas basin of Mexico. Recent evidence suggests this radiation achieved through polymorphism rather than speciation (Sage and Selander 1975. Proc. Natl. Acad. Sci. 72: 4669-73).



DISTRIBUTION AND HABITAT: Our only native cichlid. Appears to have been originally restricted to lower reaches of Rio Grande drainage (Brown 1953. Tex J. Sci. 5:245-51). Subsequently established in Edwards Plateau region of central TX, particularly in larger springs and their outflows where winter water temperatures are favorable. Also introduced in FL. Hubbs (1951. Copeia: 297) found minimum temperature tolerance in Colorado River at Austin, TX, was between 14°C and 19°C.

ADULT SIZE: 75-150 mm SL.

BIOLOGY: Rio Grande cichlids from northeastern Mexico appear to be detritivorous (Darnell 1962. Publ. Inst. Mar. Sci. 8:299-365; Birkhead unpubl.). Buchanan (1971. Ph.D. diss., Univ. Texas) however, found that

individuals from constant temperature headwaters of San Marcos River in central TX were almost exclusively herbivorous, while those from Rio Grande valley in south TX were omnivorous. He speculated that dietary shifts may have occurred in response to competition from ecologically equivalent centrarchids. Cichlid populations in Cuatro Ciénegas comprised of snail-eating and detritus or algae-feeding morphs and piscivorous forms that are not as well differentiated (Sage and Selander 1975). Buchanan (1971) found breeding in San Marcos River from March to August with peak reproductive activity in April. Population from northeastern Mexico appear to spawn during late spring based on condition of gonads (Darnell 1962; Birkhead unpubl.).

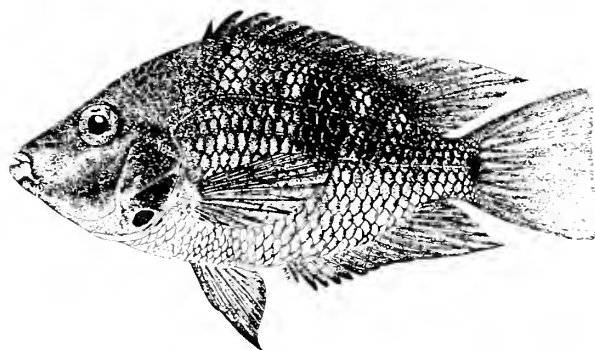
Compiler: W. S. Birkhead. December 1978.

Cichlasoma meeki (Brind)
Firemouth

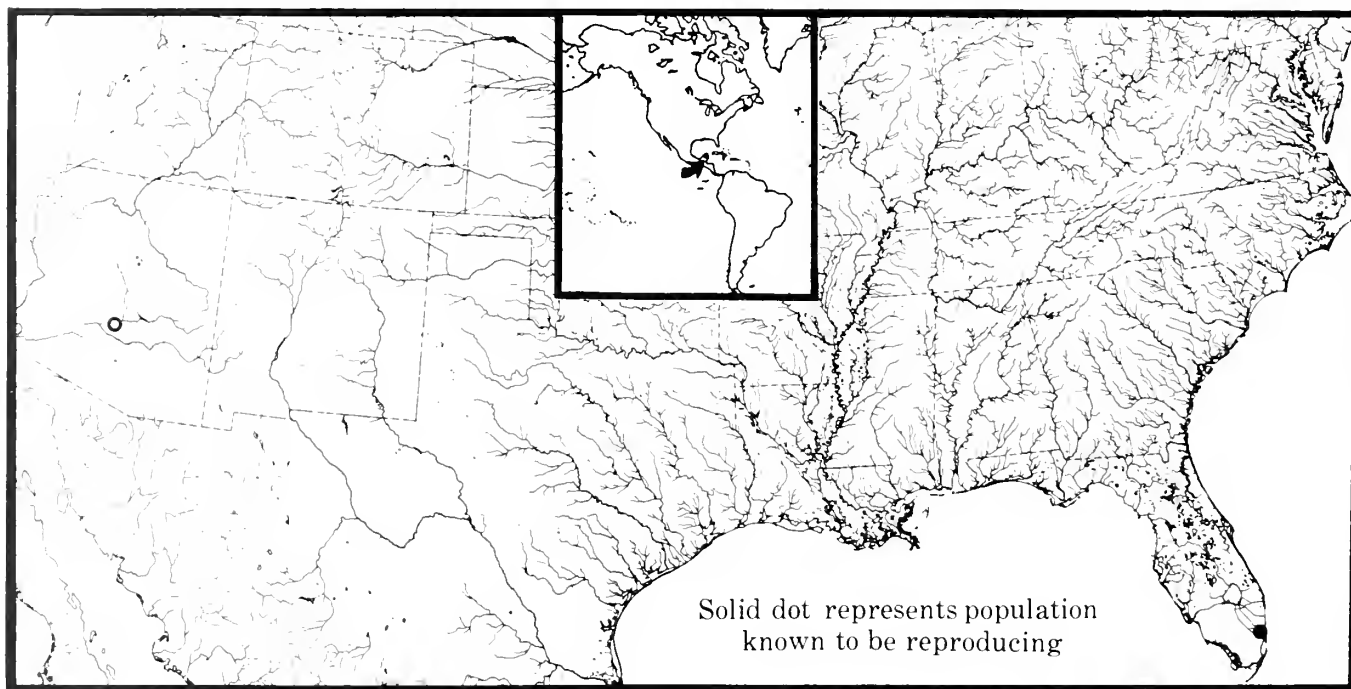
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Progreso, Yucatan, Mexico (Brind 1918. *Aquatic Life* 3:119-20).

SYSTEMATICS: In section *Thorichthys*. Systematics discussed by Hubbs (1936. *Carnegie Inst. Wash. Publ.* 457:157-287) and Miller and Nelson (1961. *Occas. Pap. Mus. Zool. Univ. Mich.* 622:1-9).



FL: Palm Beach Co. (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Cienagas and pools on northern part of the Yucatan Peninsula, Mexico. Established in canals in Dade Co., FL, where it expanded its range 8 km in two years. Has been collected in Mesa, AZ. Appears to have broad salinity tolerance. Abundant at FL localities. Introductions into United States due to escapes from fish farms and releases of home aquarium fish.

ADULT SIZE: In Yucatan 49-73 mm SL, 150 mm SL maximum.

BIOLOGY: Omnivorous, but feeding mainly on algae. Eggs are laid on substrate and parents incubate eggs and guard young. In FL spawning occurs during February-September at 25-33°C. Behavior studied by Baerends and Baerends-Van Roon (1950. *Behaviour, Suppl.* 1:1-243). Literature on spawning behavior summarized by Breder and Rosen (1966. *Modes of Reproduction in Fishes*).

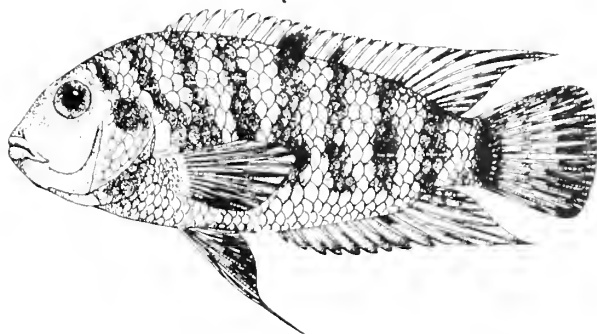
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Cichlasoma nigrofasciatum (Günther)
Convict cichlid

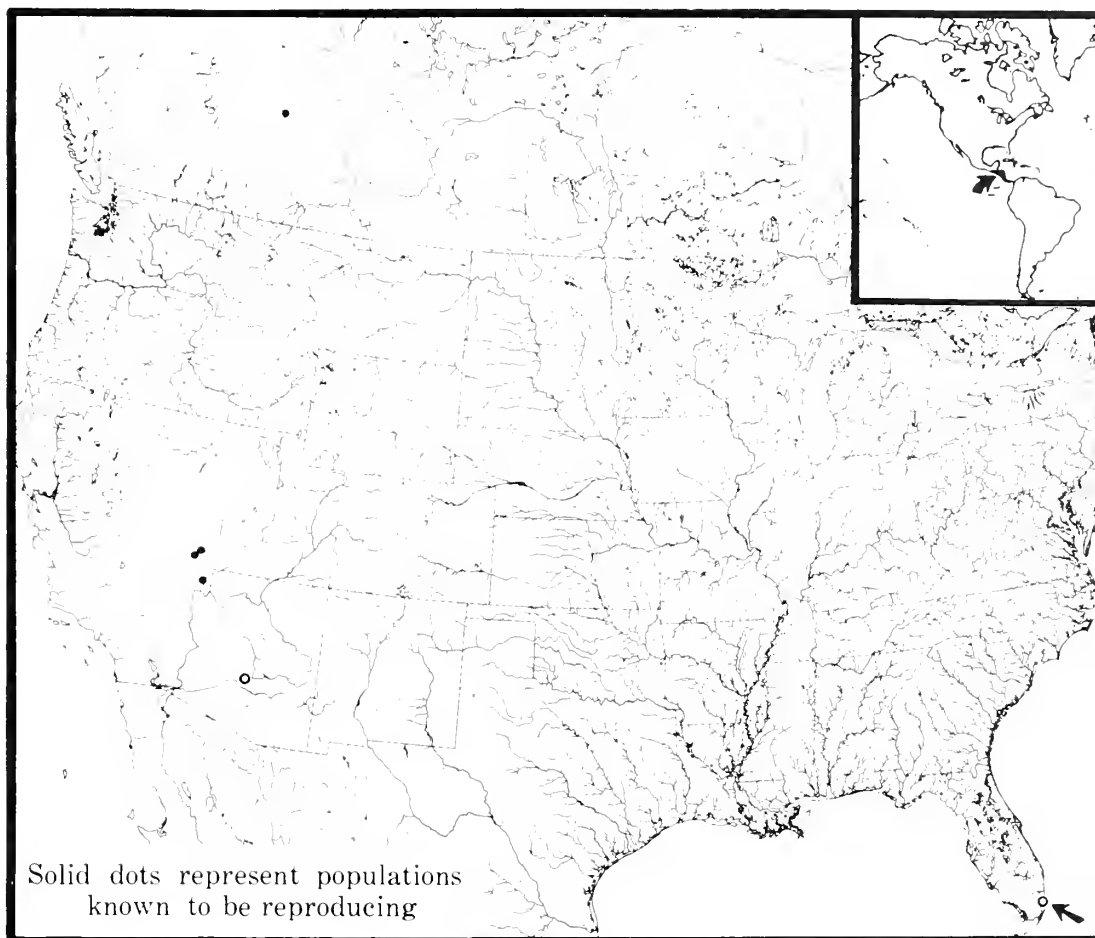
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Lakes of Amititlan and Atitlan, Guatemala (Günther 1869. Trans. Zool. Soc. Lond. 6:377-494).

SYSTEMATICS: Last major revision was that of Regan (1905. Ann. Mag. Nat. Hist. [Ser. 7] 16:60-77, 225-43, 316-40, 433-45; and 1906-08. *Biologia Centrali-Americana. Pisces*, Vol. 8). Placed in section *Archocentrus*. Included in key to freshwater fishes of AZ by Minckley (1973. *Fishes of Arizona*).



AT: Banff National Park, 67 mm SL (NMC).



DISTRIBUTION AND HABITAT: Native distribution — Pacific slope of Guatemala to Costa Rica; both slopes of Costa Rica. Established in springs in Lincoln and Clark cos., NV, and in Cave and Basin Hotspring, AT, Canada. Was and possibly still is established in the Phoenix area, AZ. Common at North American localities. Has been collected from Miami, FL. Has potential to inflict serious damage on native fishes of southwestern United States through competition and possibly predation. Most or all introductions appear to have been due to releases by aquarists.

ADULT SIZE: 80-90 mm SL, 100 mm SL maximum.

BIOLOGY: Sexually dimorphic in shapes of dorsal and anal fins. Eggs laid on cleaned surfaces of rocks, and parents incubate eggs and guard young. Summary of literature on spawning behavior presented by Breder and Rosen (1966. *Modes of Reproduction in Fishes*). Exhibits a great deal of intra- and interspecific aggression.

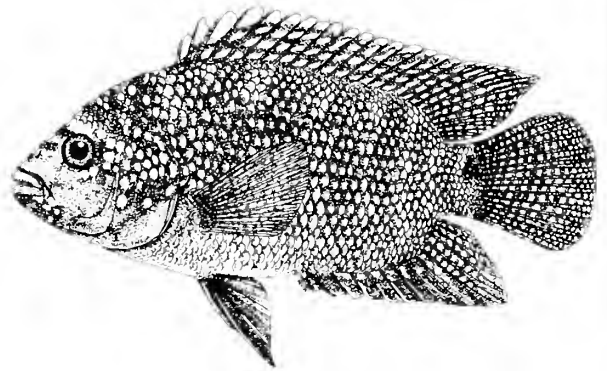
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Cichlasoma octofasciatum (Regan)
Jack Dempsey

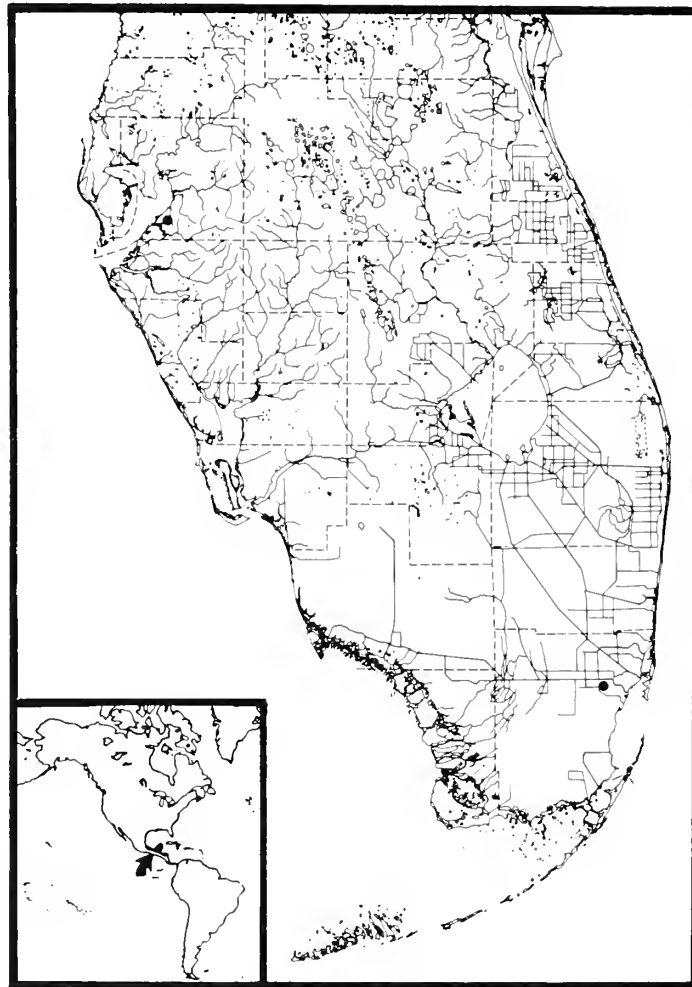
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Mexico (Regan 1903. *Revue Suisse Zool.* Geneve 11:413-18).

SYSTEMATICS: In section *Archocentrus*. Systematics treated by Regan (1905. *Ann. Mag. Nat. Hist.* [Ser. 7] 16:60-77, 225-43, 316-40, 433-45; and 1906-08. *Biologia Centrali-Americana. Pisces*, Vol. 8) and Hubbs (1936. *Carnegie Inst. Wash. Publ.* 457:157-287). *Cichlasoma biocellatum* considered a junior synonym of *C. octofasciatum*.



FL: Palm Beach Co. (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Springs and rivers on the Atlantic slope of Central America from near Veracruz City, Mexico, to the Rio Ulua basin, Honduras. Established in canals in Hillsborough and Dade cos., FL. Not abundant at FL localities. Introductions due to intentional or accidental releases from fish farms.

ADULT SIZE: In FL 50-100 mm SL, 200 mm SL maximum.

BIOLOGY: In FL appears to feed mainly on filamentous algae. Eggs are laid on substrate, and parents incubate eggs and guard young. Behavior studied by Baerends and Baerends-Van Roon (1950. *Behaviour*, Suppl. 1:1-243). Literature on spawning behavior summarized by Breder and Rosen (1966. *Modes of Reproduction in Fishes*).

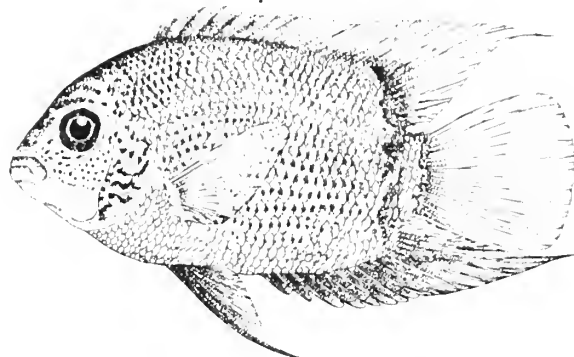
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Cichlasoma severum (Heckel)
Banded cichlid

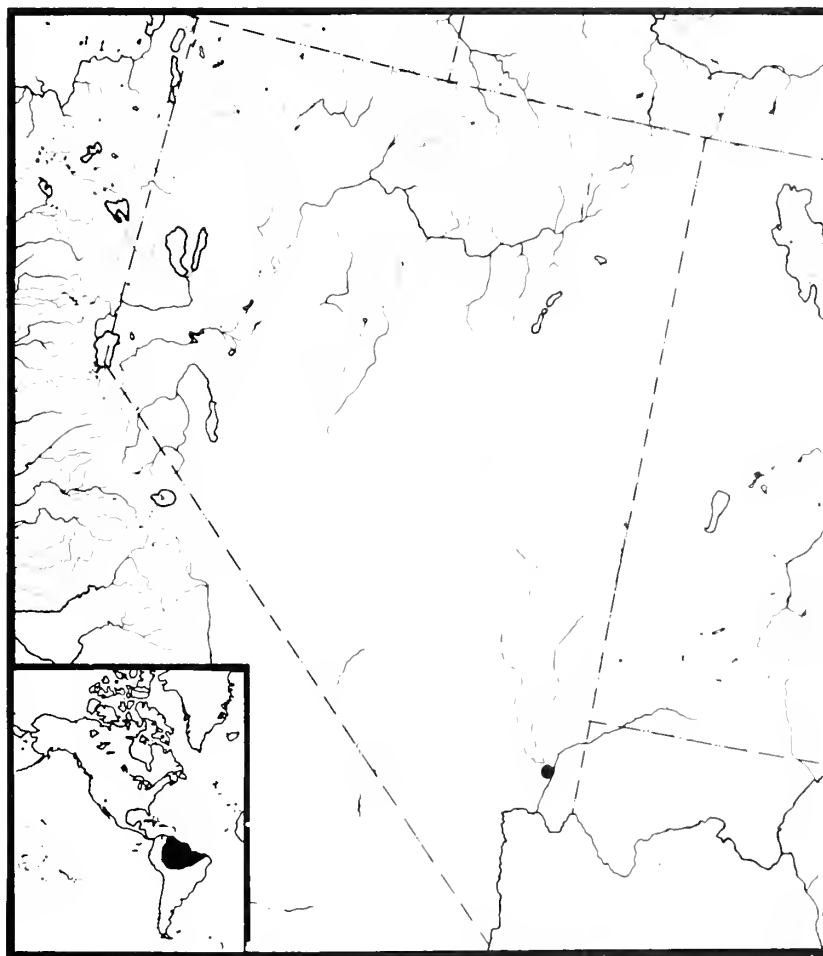
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Rio Negro, near Marabitanas, Brazil (Heckel 1840. Ann. Wiener Mus. 2:325-470).

SYSTEMATICS: In section *Heros* (Regan 1905. Ann. Mag. Nat. Hist. [Ser. 7] 16:60-77, 225-43, 316-40, 433-45).



NV: Clark Co., Rogers Spring, male, 75 mm SL (UNLV).



DISTRIBUTION AND HABITAT: Native distribution — Brazil, Surinam, Guyana, French Guiana, and southern and eastern Venezuela. Probably established in Rogers Spring, Clark Co., NV. Introductions probably due to releases by local aquarists.

ADULT SIZE: In native range 100-170 mm TL, 200 mm SL maximum.

BIOLOGY: Feeds mainly on fruits, seeds, green algae, and detritus in native range (Lowe-McConnell 1969. J. Linn. Soc. Lond.

[Zool.] 48:255-302; and Knöppel 1970. Amazoniana 2:257-352). Eggs are laid on substrate and parents incubate eggs and guard young. Males with rows of dark spots on sides; females with few, if any spots. Literature on spawning behavior summarized by Breder and Rosen (1966. *Modes of Reproduction in Fishes*). Data on growth and reproduction in native range presented by Lowe-McConnell (1964. J. Linn. Soc. Lond. [Zool.] 45:103-44; 1969).

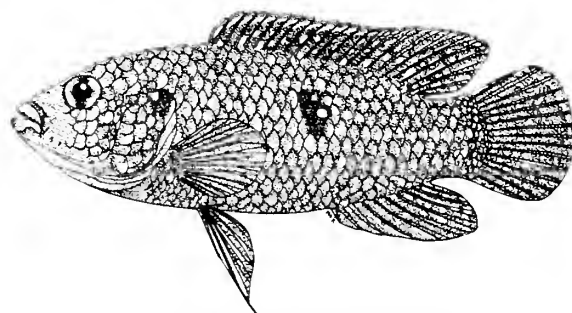
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Hemichromis bimaculatus Gill
Jewelfish

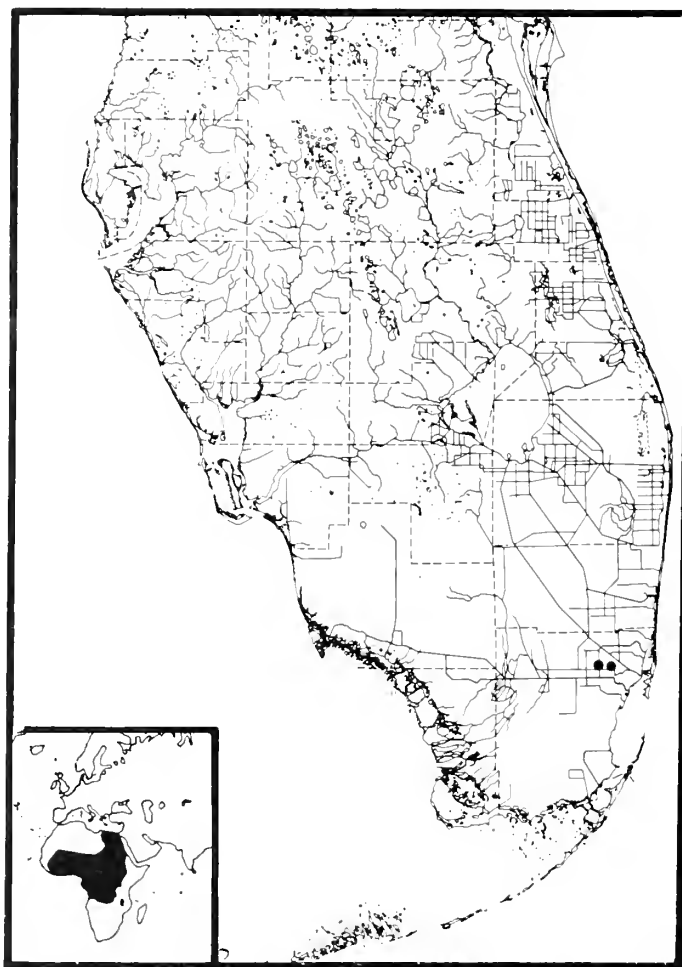
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Unknown, probably Liberia (Gill 1863. Proc. Acad. Nat. Sci. Phila. [1862]14:134-9).

SYSTEMATICS: Recent evidence indicates genus contains two other species, *H. fasciatus* and *H. elongatus* (Fryer and Iles 1972. *The Cichlid Fishes of the Great Lakes of Africa*; Trewavas 1974. Bull. Br. Mus. [Nat. Hist.] Zool. 26:331-419).



FL: Dade Co. (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Northern and western Africa; principally riverine. Established in canals in Dade Co., FL. Appears to have broad salinity tolerance. Common at FL localities. First collected near Miami International Airport.

ADULT SIZE: In FL 69-80 mm SL, 240 mm SL maximum.

BIOLOGY: Omnivorous. Eggs are laid on substrate, and parents incubate eggs and guard young. In FL spawning occurs from February through summer months at 26-33°C. Literature on spawning, larval development, and communication reviewed by Fryer and Iles (1972). Behavior studied by Baerends and Baerends-Van Roon (1950. Behaviour, Suppl. 1:1-243).

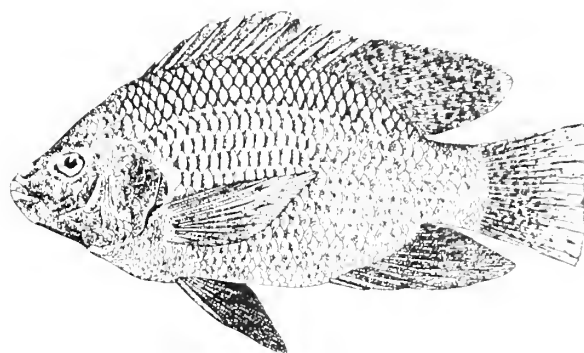
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Tilapia aurea (Steindachner)
Blue tilapia

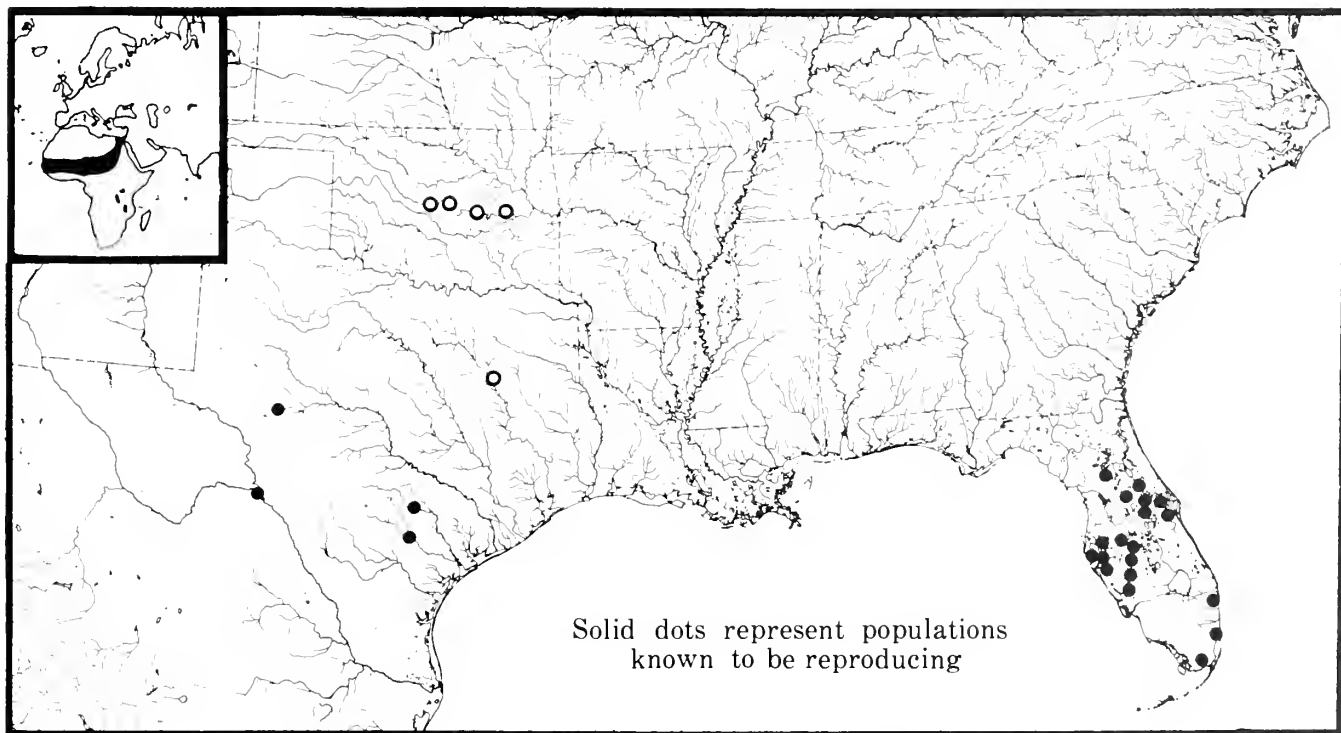
Order Perciformes
Family Cichlidae

TYPE LOCALITY: West Africa (Steindachner 1864. Verh. Zool. Bot. Ges. Wien 14:223-32).

SYSTEMATICS: Considered to be in group *Sarotherodon* by Thys van den Audenaerde (1968. Mus. Roy. Afr. Centr., Belgium, Doc. Zool. 14:1-406); group elevated to genus by Trewavas (1973. Bull. Brit. Mus. [Nat. Hist.] Zool. 25:1-26). Classification of Thys van den Audenaerde (1968) followed in present account. Has been confused with *T. nilotica* in much of the literature; distinguished by Trewavas (1966. Israel J. Zool. 14:258-76). Included in key to AL fishes by Smith-Vaniz (1968. *Freshwater Fishes of Alabama*).



FL: Polk Co., Lake Parker
(FAU).



DISTRIBUTION AND HABITAT: Native distribution — Senegal, middle Niger, Benue River (?), Chad, lower Nile, Jordan River system, and hot pools at Ein Fashkha. Established in TX and FL. Previously established population in OK is probably no longer extant. Possibly established in AZ, GA, and CO. Annually stocked in ponds and lakes in AL. Introduced into NC but did not survive. Able to live and reproduce in fresh and brackish water. Established in brackish water in Tampa Bay, FL. Lower temperature tolerance ca. 13°C. Abundant at United States localities. Introductions into United States due to intentional releases by government

agencies, escapes from fish farms, and intentional releases into power plant cooling reservoirs.

ADULT SIZE: In FL 120-200 mm SL, 508 mm TL maximum, both sexes included.

BIOLOGY: Feeds primarily on phytoplankton. Maternal mouthbrooder. Exhibits male growth superiority (Fryer and Iles 1972. *The Cichlid Fishes of the Great Lakes of Africa*).

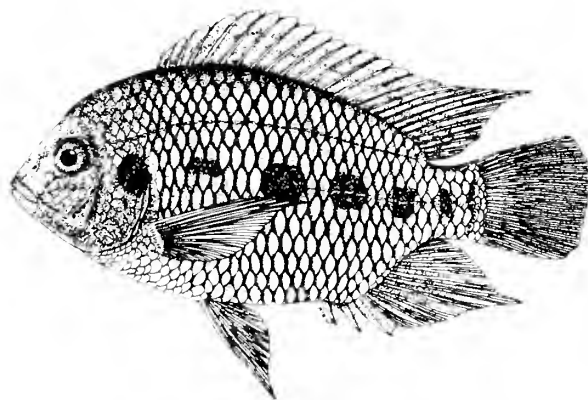
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Tilapia mariae Boulenger
Spotted tilapia

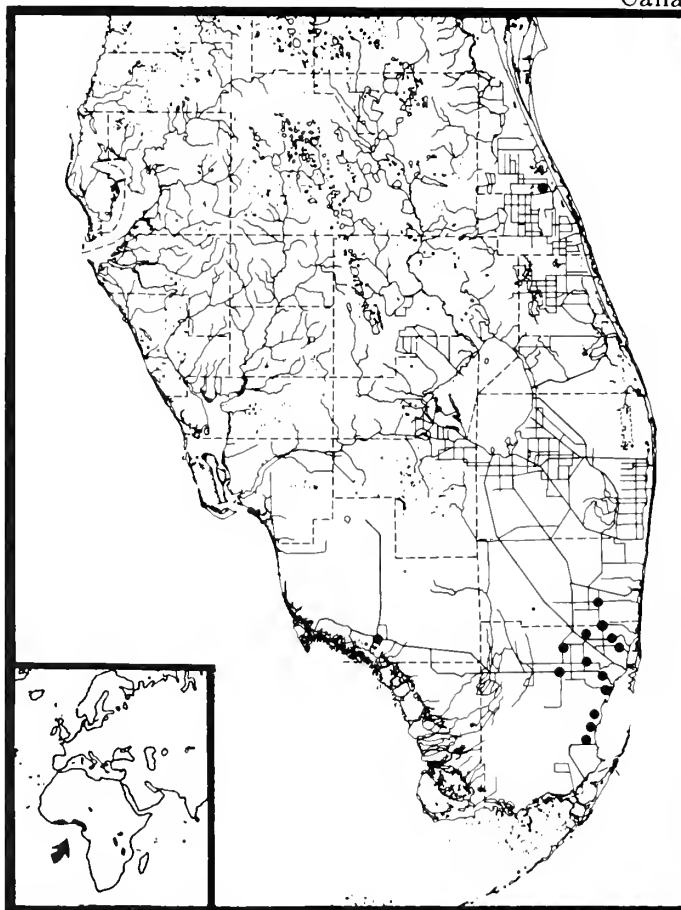
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Azumine Creek, Opobo River, Niger Delta (Boulenger 1899. Proc. Zool. Soc. Lond.:98-143).

SYSTEMATICS: In group *Tilapia*. Systematics treated by Thys van den Audenaerde (1966. Ann. Mus. Roy. Afr. Centr., Belgium, [Ser. 8] Sci. Zool. 153:1-98; and 1968. Mus. Roy. Afr. Centr., Belgium, Doc. Zool. 14:1-406).



FL: Dade Co., Snapper Creek Canal, 145 mm SL (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Lowland coastal forests and lagoons from middle Ivory Coast to southwestern Ghana and from southeastern Dahomey to Kribi, Cameroon. Established in freshwater canals in Collier, Broward, and Dade cos., and has been collected in Brevard Co., FL. Has rapidly expanded its range in FL since first reported in 1974 and is now the dominant fish at many localities. Has possibly been experimentally introduced in some waters in southern AZ. Appears to have broad salinity and temperature tolerances. Introductions into FL due to accidental or intentional releases from fish farms.

ADULT SIZE: In FL 150-200 mm SL, 230 mm SL maximum.

BIOLOGY: In native range, is probably an Aufwuchs grazer; however, will feed on phytoplankton in unusually rich waters (Trewavas 1974. Bull. Brit. Mus. [Nat. Hist.], Zool. 26:331-419). Not a mouth-brooder; lays small turquoise-blue eggs on the substrate and guards the newly-hatched young. Spawns throughout year in FL. Juveniles marked with a series of vertical dark bars (Courtenay and Hensley 1979. Environ. Conserv. 6:149-51).

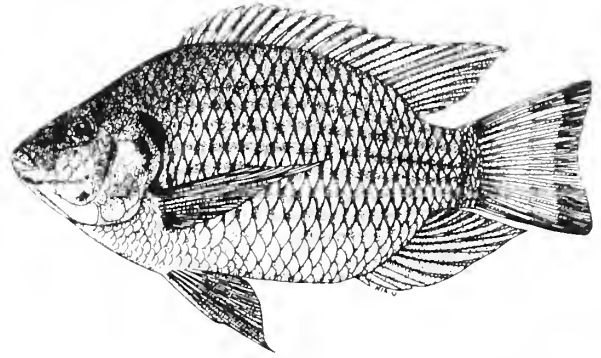
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Tilapia melanotheron (Rüppell)
Blackchin tilapia

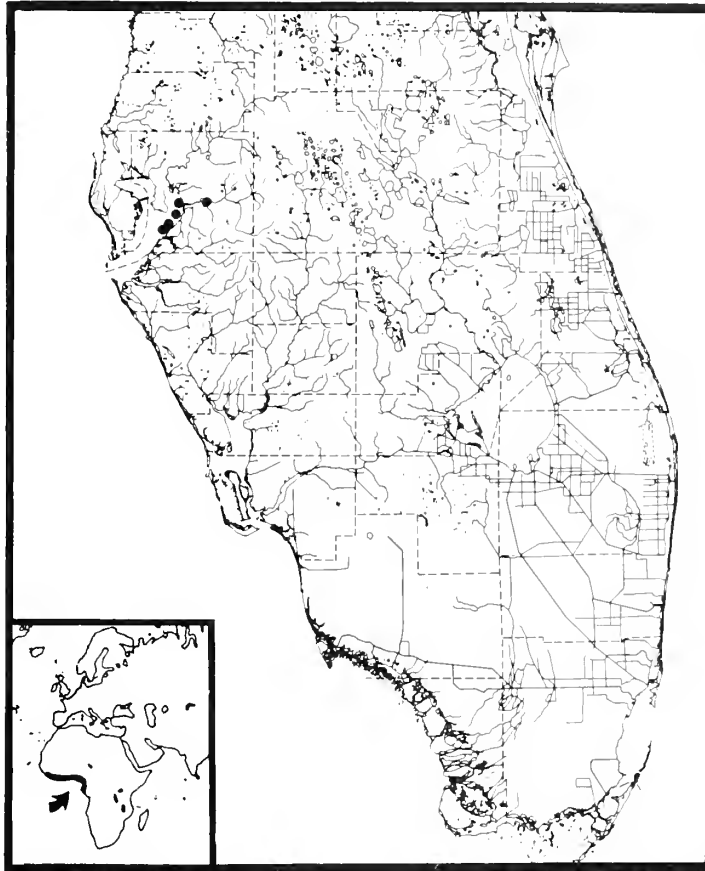
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Gold Coast (=Ghana; Rüppell 1852. *Verzeichniss der in dem Museum der Senkenbergischen naturforschenden Gesellschaft aufgestellten Sammlungen. Vierte Abteilung: Fische und deren Skelette*:1-40).

SYSTEMATICS: Considered to be in group *Sarotherodon* by Thys van den Audenaerde (1968. *Mus. Roy. Afr. Centr., Belgium, Doc. Zool.* 14:1-406); group elevated to genus by Trewavas (1973. *Bull. Brit. Mus. [Nat. Hist.], Zool.* 25:1-26). Classification of Thys van den Audenaerde (1968) followed in present account. *Tilapia macrocephala* is a junior synonym. Confused with *T. heudelotii* in much of the United States literature. Included in keys by Moore (in Blair et al. 1968. *Vertebrates of the United States*).



FL: Hillsborough Co., Tampa Bay, female, 186 mm SL (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Brackish water from middle Liberia to southern Cameroon. Established in estuaries on eastern side of Tampa Bay and Alafia River to Lithia Spring, Hillsborough Co., FL. Has been collected from waters with salinities near that of sea water. In FL population has survived winter water temperatures of 11°C. Range has not expanded since first noted in 1958. Basis for small commercial fishery. Introduction probably due to escapes from fish farms.

ADULT SIZE: In FL 130-220 mm SL, 240 mm SL maximum.

BIOLOGY: In FL feeds predominately on phytoplankton, detritus, and filamentous algae. Paternal mouthbrooder. Minimal temperature of 25°C required for spawning. In FL spawns during April or May to December in brackish water (Finucane and Rinckey 1964. *Proc. 18th Ann. Conf., South-eastern Assoc. Game Fish Comm.*:1-11).

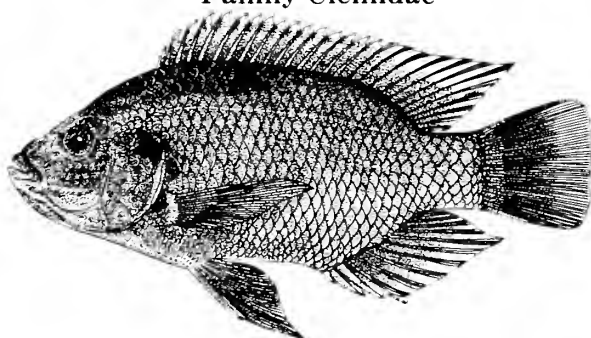
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Tilapia mossambica (Peters)
Mozambique tilapia

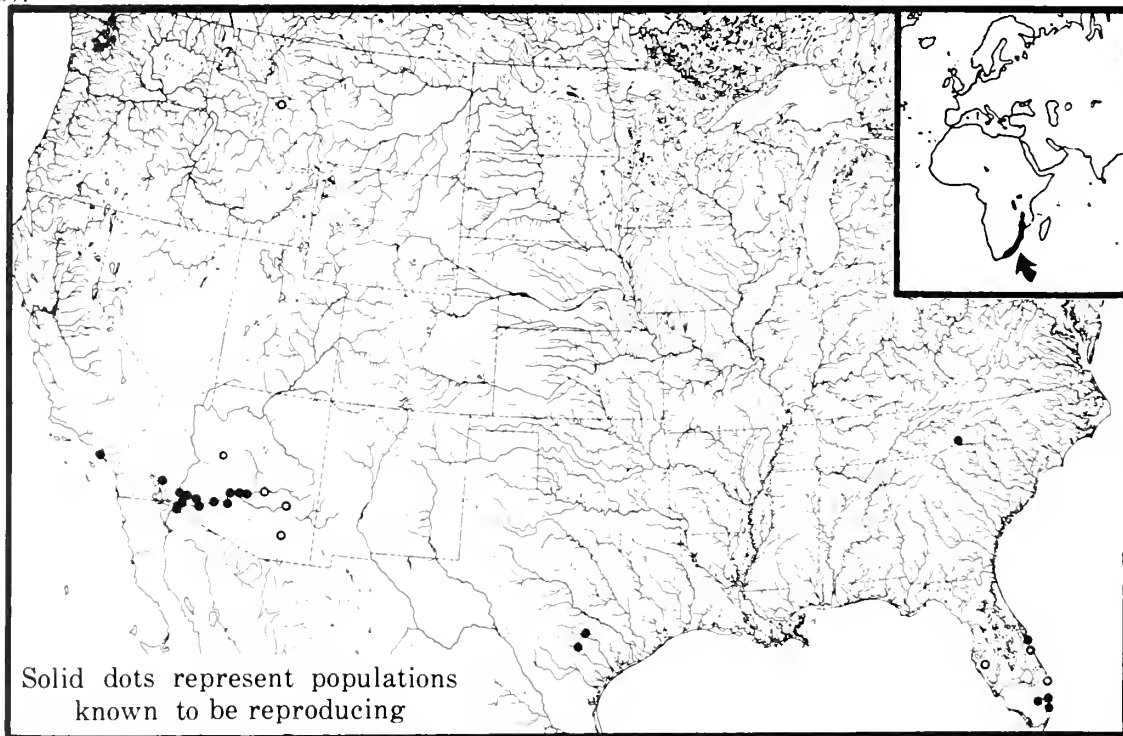
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Tette, Sena, Quelimane, Lumbo, Inhambane, and Querimba, Mozambique (Peters 1852. Monatsber. Akad. Wiss. Berlin:681-85).

SYSTEMATICS: Considered to be in group *Sarotherodon* by Thys van den Audenaerde (1968. Mus. Roy. Afr. Centr., Belgium, Doc. Zool. 14:1-406); group elevated to genus by Trewavas (1973. Bull. Brit. Mus. [Nat. Hist.], Zool. 25:1-26). Classification of Thys van den Audenaerde (1968) followed in present account. *Tilapia natalensis* is a junior synonym. Included in keys to freshwater fishes of United States by Moore (1968. in Blair et al. *Vertebrates of the United States*), AZ by Minckley (1973. *Fishes of Arizona*), CA by Moyle (1976. *Inland Fishes of California*), and AL by Smith-Vaniz (1968. *Freshwater Fishes of Alabama*).



FL: Dade Co., Snapper Creek,
177 mm SL (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Lower Zambezi River, lower Shire River, and from the Zambezi delta to Algoa Bay. Established in CA, AZ, TX, FL, and NC. Possibly established in GA and CO. Has been collected in MT and NY and is annually stocked in ponds and lakes in AL. Able to live and reproduce in fresh water and sea water. Established in estuarine and probably marine waters in CA. Can tolerate temperatures of 12°C in fresh water and at least as low as 11°C in saline water. Prefers slow or still, weedy waters. Abundant at some United States localities. Introductions into United States due to intentional releases by government agencies

and aquarists and escapes from government hatcheries, private fish farms, and a public aquarium.

ADULT SIZE: 140-220 mm SL, 360 mm SL maximum.

BIOLOGY: Omnivorous. Maternal mouth-brooder. Sexual dimorphism in frontal profile and mouth size. Summary of life history information given by Fryer and Iles (1972. *The Cichlid fishes of the Great Lakes of Africa*). Behavior studied by Baerends and Baerends-Van Roon (1950. Behaviour, Suppl. 1:1-243) and Neil (1964. Univ. Calif. Publ. Zool. 75:1-58).

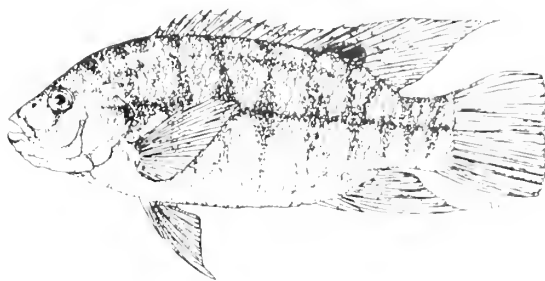
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Tilapia zillii (Gervais)
Redbelly tilapia

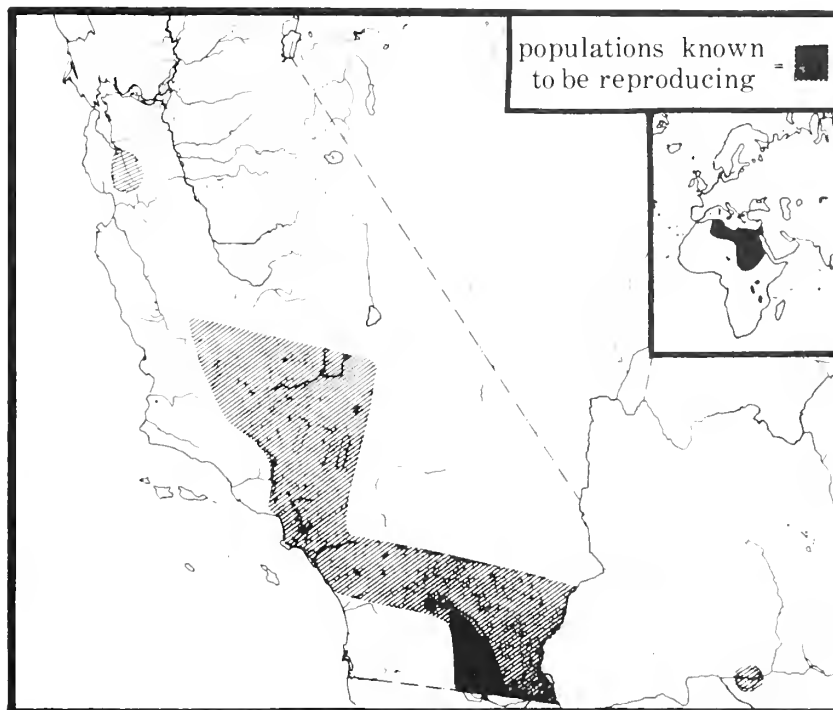
Order Perciformes
Family Cichlidae

TYPE LOCALITY: Tuggurt, Algeria (Gervais 1848. Ann. Sci. Nat. [Ser. 3] Zool. 10:202-08).

SYSTEMATICS: In subgenus *Coptodon*. Systematics treated by Thys van den Audenaerde (1964. Ann. Mus. Roy. Afr. Centr., Belgium, [Ser. 8] Sci. Zool. 124: 1-155; and 1968. Mus. Roy. Afr. Centr., Belgium, Doc. Zool. 14:1-406). *Tilapia melanopleura* considered a junior synonym of *T. zillii* (Thys van den Audenaerde 1968). Included in keys to freshwater fishes of CA (Moyle 1976. *Inland Fishes of California*), AZ (Minckley 1973. *Fishes of Arizona*), and AL (Smith-Vaniz 1968. *Freshwater Fishes of Alabama*). However, identification of species in United States is uncertain; species is possibly the closely related *T. guineensis* or *T. rendalli*, or more than one species or even hybrids may be involved.



CA: Imperial Co., 12 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Native distribution — Rivers and lakes in north and central Africa to Jordan. Established in irrigation canals in Imperial Valley, CA. Probably established in Coachella and Palo Verde valleys, including Salton Sea and lower Colorado River. Introduced into other areas of state. Has been collected from marine waters in southern CA. Established populations in FL were eradicated. Introduced and is possibly established in AZ. Annually stocked in farm ponds and lakes in AL. Appears to be displacing *Cyprinodon macularius* in Salton Sea area. Can live and reproduce in waters with salinities as high as 45 ppt. Lower lethal tempera-

ture is ca. 10-11°C. Most introductions made by governmental agencies for aquatic weed control.

ADULT SIZE: In Imperial Valley, CA, 170-250 mm TL, 300 mm SL maximum.

BIOLOGY: Omnivorous. Not a mouth-brooder; lays oblong eggs on substrate, and parents guard eggs and young. Exhibits male growth superiority. Literature on life history summarized by Fryer and Iles (1972. *The Cichlid Fishes of the Great Lakes of Africa*) and Moyle (1976).

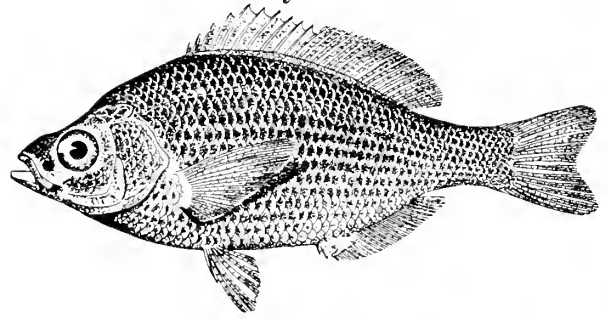
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Cymatogaster aggregata Gibbons
Shiner perch

TYPE LOCALITY: San Francisco (Gibbons 1854. Daily Placer Times and Transcript. May 18).

SYSTEMATICS: One of two species in genus; closely allied and probably the ancestral stock for *C. gracilis*. Tarp (1952. Calif. Dept. Fish. Game Fish. Bull. 88:1-99) revised family Embiotocidae, and recognized two subspecies: the nominate, and *C. a. gracilis*.

Order Percidae
Family Embiotocidae

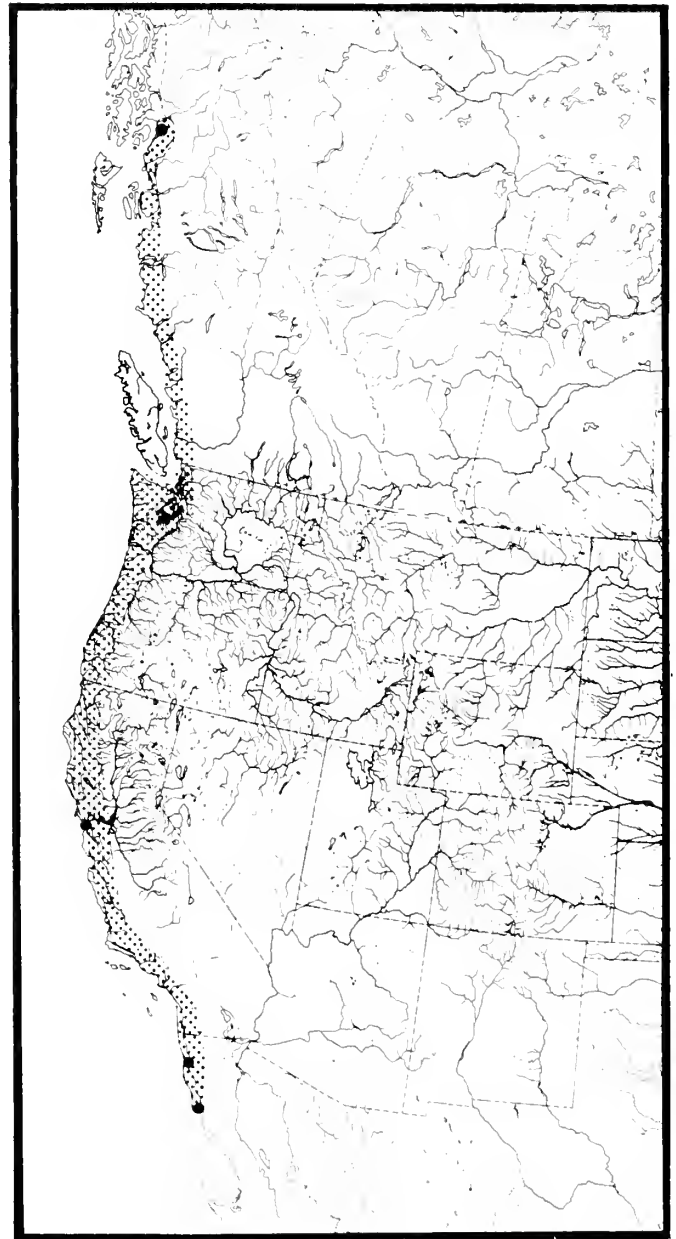


AK: Fort Wrangell, male
(Jordan and Evermann 1900).

DISTRIBUTION AND HABITAT: Abundant and widely distributed along Pacific coast from San Quintin Bay, Baja California north to Port Wrangel, AK. Common in lower reaches of CA streams. In BC, reported in shallow waters during summer and fresh water to depths of 73 m during winter.

ADULT SIZE: 80-150 mm SL.

BIOLOGY: Period between mating and birth of young approximately one year (Gorden 1965. M.S. thesis. Univ. British Columbia), at which time females seek out shallow waters for protection of young from ocean predators. Viviparous, producing five to 17 (56-78 mm) young (Gorden 1965). Males are sexually mature when born. Ninety-nine percent of females of age class II are gravid. Foods change with age, season, and differ for each sex. Food of young mainly copepods. Adults feed on mussels, algae, and occasionally barnacle appendages. Light important in stimulating feeding (Gorden 1965).



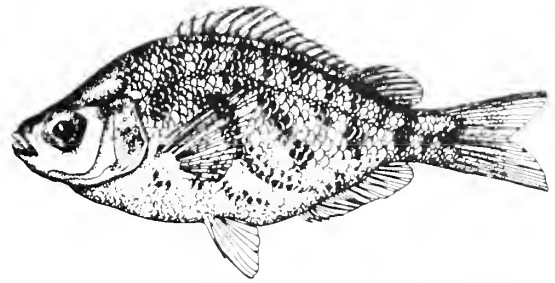
Compiler: S. P. Platania. March 1980.

***Hysterocarpus traski* Gibbons**
Tule perch

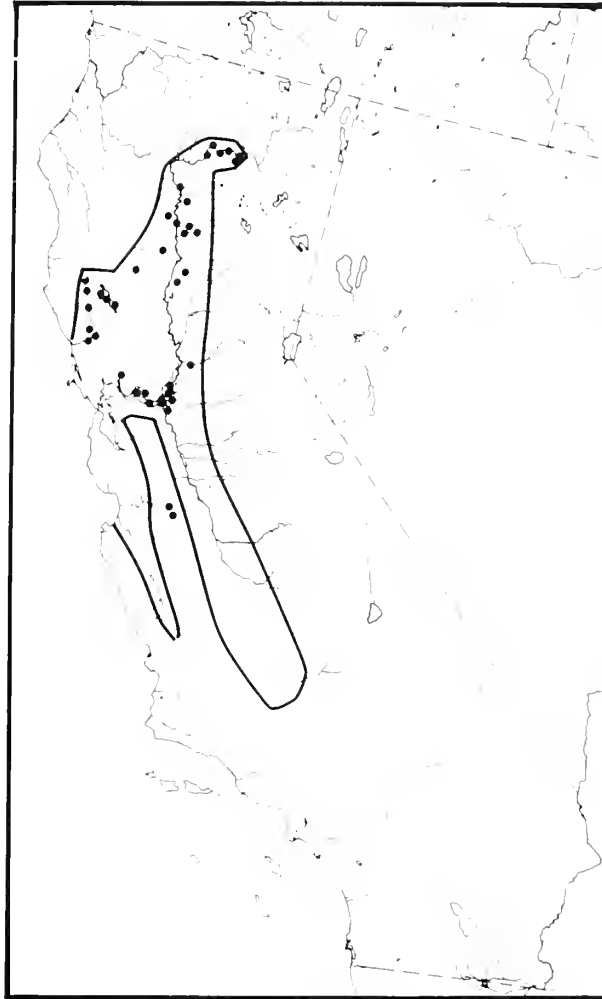
Order Perciformes
Family Embiotocidae

TYPE LOCALITY: Sacramento River, CA (Gibbons 1854. Daily Placer Times and Transcript, May 18).

SYSTEMATICS: Monotypic. Only exclusively freshwater embiotocid. Hopkirk (1973. Univ. Calif. Publ. Zool. 96:1-135) described three subspecies: *H. t. lagunae* from Russian River, *H. t. pomo* from Clear Lake, and *H. t. traski* from Sacramento Valley.



CA: Mendocino Co., Sacramento River, 60 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Abundant in low elevation sections of Sacramento River and major tributaries, CA, including Pit River up to Pit Falls. Also abundant in Clear Lake, Lake Co., and Russian River. Extinct in Pajaro-Salinas drainage and San Joaquin River system. Line on map outlines former range; dots indicate recent records only.

BIOLOGY: Livebearer, each female giving birth to 20-80 young. Juveniles may be sexually mature a few weeks after birth. Feeds on both benthic and planktonic invertebrates and lives up to seven years. (Moyle 1976. *Inland Fishes of California*).

ADULT SIZE: 100-150 mm SL.

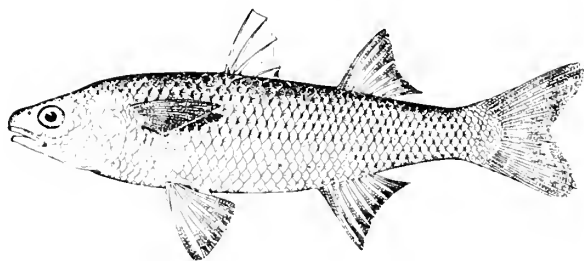
Compiler: P. B. Moyle. July 1978.

Agonostomus monticola (Bancroft)
Mountain mullet

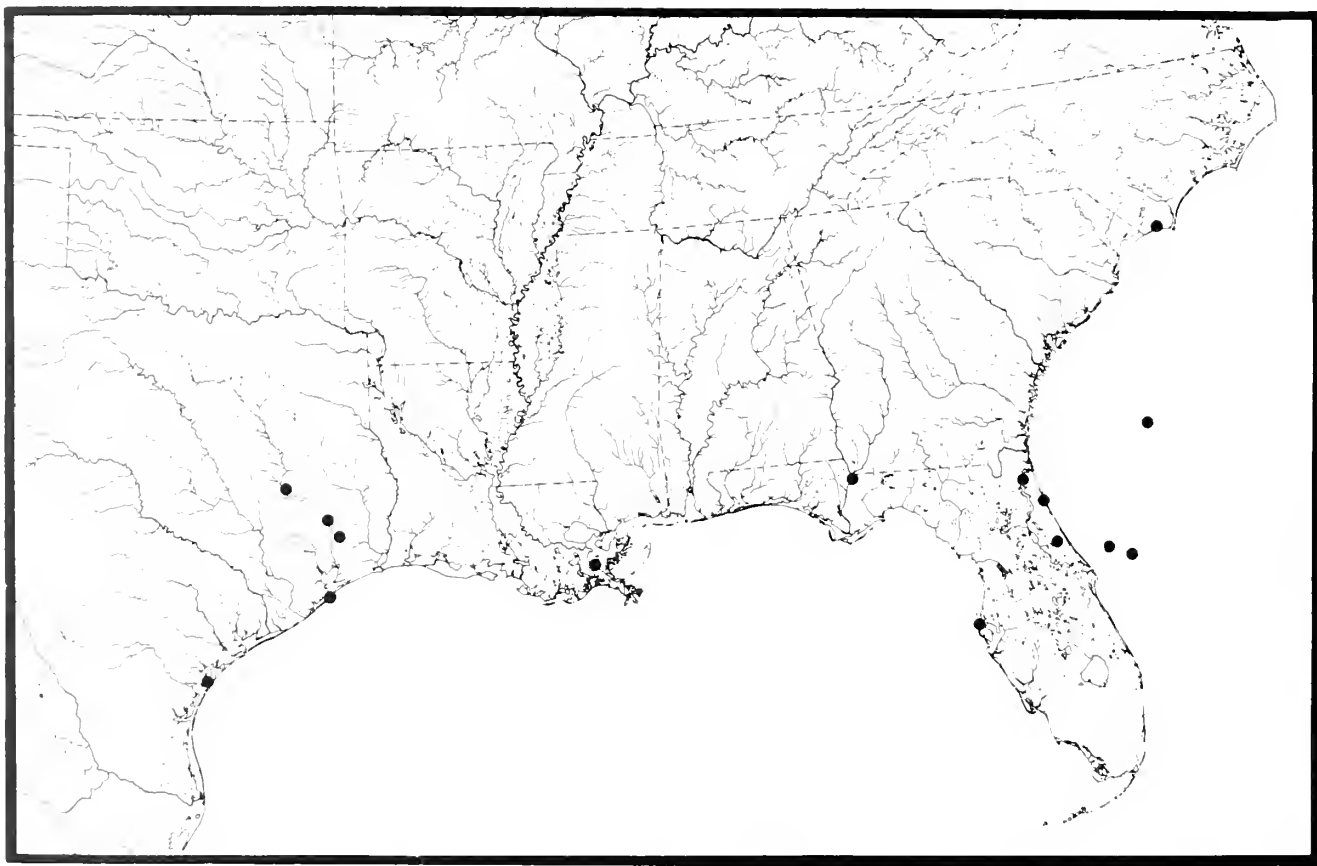
Order Perciformes
Family Mugilidae

TYPE LOCALITY: Jamaica (Bancroft in Griffith's 1836 edition of Cuvier's *The Animal Kingdom*, class Pisces [1834] :1-680).

SYSTEMATICS: Subfamily Gestræinae. Genus *Agonostomus* includes several species occurring in eastern Pacific, Atlantic, and eastern Indian oceans with *A. monticola* apparently the only species in the western Atlantic area. Among other mugilid genera in western Atlantic, *Joturus* appears to be most closely related.



Mexico (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Along United States Atlantic coast from NC to TX. Also known from Mexico, central America, the West Indies and northern South America (at least south to Columbia and Venezuela). Adults and subadults ascent tropical and subtropical streams, often to the headwaters. Young occur at sea and have been found drifting in currents hundreds of miles from shore. Rare and scattered.

ADULT SIZE: ca. 225 mm.

BIOLOGY: Apparently a catadromous species with young collected far out at sea and large specimens (722 mm) collected in freshwater (Anderson 1957. Fish. Bull. [120] U.S. Fish Wildl. Ser. 57:415-25). Presumably a filter feeder similar to species of *Mugil*. Available information on life history and ecology summarized by Gilbert (in Gilbert 1978. *Rare and Endangered Biota of Florida* 4:39-40).

Compiler: F. C. Rohde. December 1979.

Mugil cephalus Linnaeus
Striped mullet

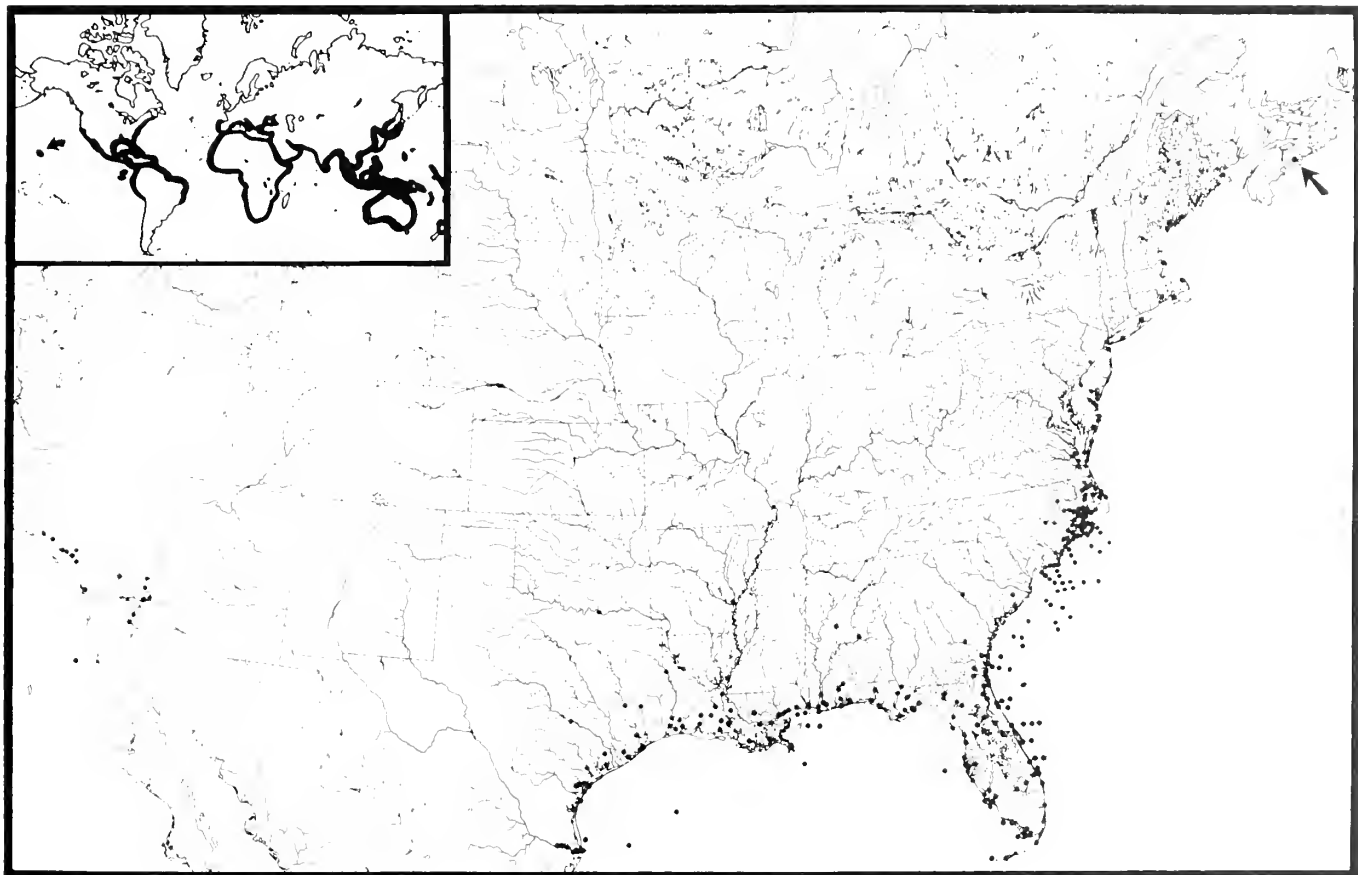
Order Perciformes
Family Mugilidae

TYPE LOCALITY: Europe (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: J. R. Thomson is currently studying systematics of family. The cosmopolitan *M. cephalus* may prove to represent more than one species (de Sylva et al. 1956. Fla. State Board Conserv. Tech. Ser. 19:7-45).



Mexico: 19 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Marine and estuarine, often ascending coastal rivers for considerable distances, stopping at Fall Line. Considered to have worldwide circum-tropical distribution (Briggs 1960. Copeia: 171-80). In Atlantic, from Halifax, NS, and Muscongus Bay, ME, to Brazil, including Bermuda and many Caribbean islands, but absent from Bahamas. Most common from Chesapeake Bay south. Pacific range from Sacramento-San Joaquin Delta, CA, to Chile and Galapagos. Uncommon north of Los Angeles. Ascends Colorado River to Imperial Dam, AZ, and present in Salton Sea, CA.

ADULT SIZE: 230-350 mm SL.

BIOLOGY: Commercially important, and the subject of much regional research. Thomson (1963. FAO Fish. Synop. 1:1-80) provided synopsis of worldwide biological data. Larval development and growth documented by Anderson (1958. U.S. Fish. Wildl. Serv. Fish. Bull. 58:501-19). Migrates to off-shore marine waters to spawn (Fitch 1972. Calif. Fish Game 58:246-48, and included references). Feeds on plant material, detritus and associated fauna, and plankton (Fitch in Cato and McCullough [eds.] 1976. Fla. Sea Grant Rep. 15:63-69). Age and growth of freshwater inhabitants examined by Shireman (1964. Proc. La. Acad. Sci. 27: 39-45).

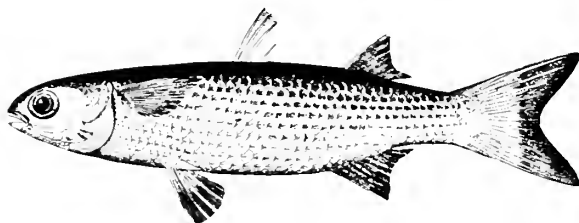
Compiler: G. H. Burgess. September 1978.

Mugil curema Valenciennes
White mullet

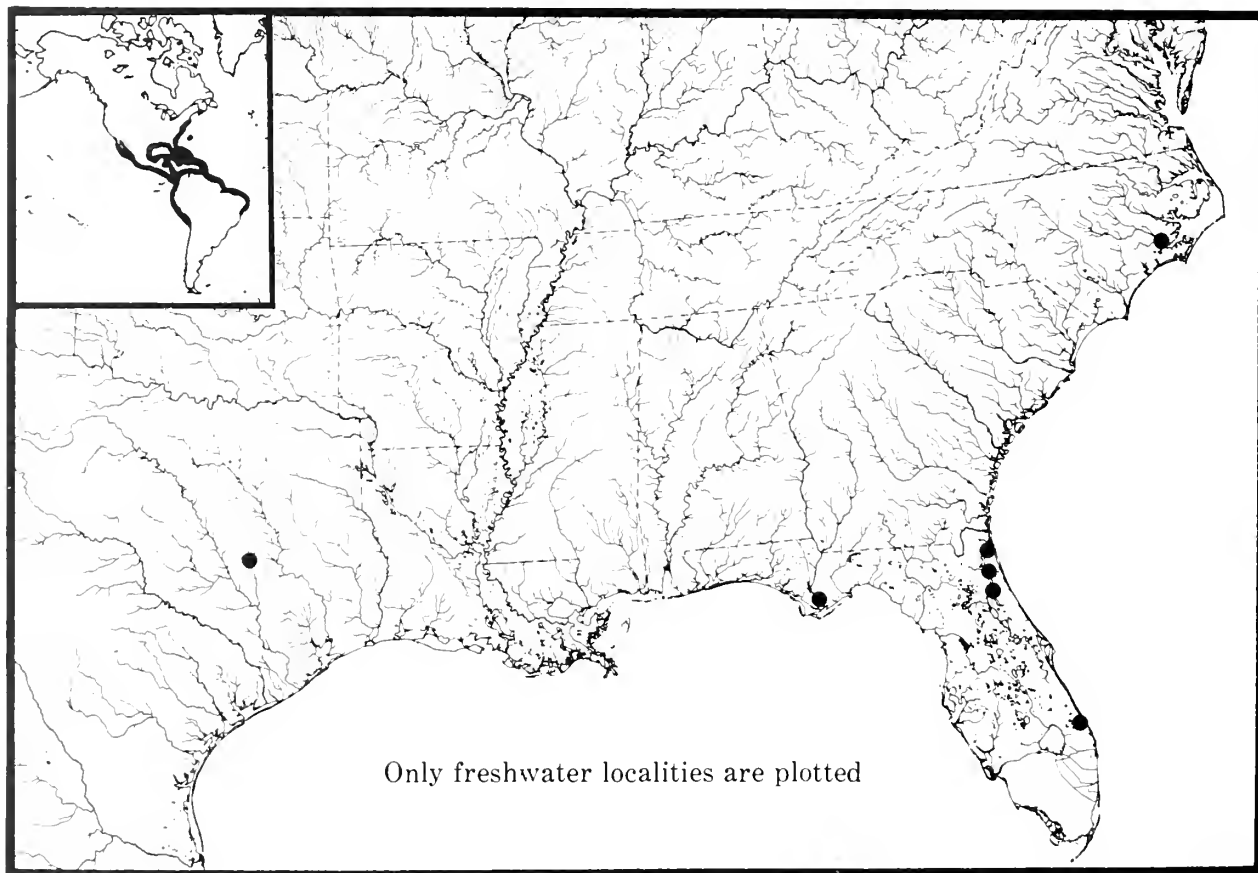
Order Perciformes
Family Mugilidae

TYPE LOCALITY: Brazil, Martinique, and Cuba (Valenciennes in Cuvier and Valenciennes 1836. *Histoire Naturelle des Poissons* Vol. 11).

SYSTEMATICS: Genus contains four species occurring in United States waters, if *M. gaimardianus* considered synonym of *M. curema* (Thomas 1977. in Fischer 1978 [ed.] *FAO Species Identification Sheets for Fishery Purposes — Western Central Atlantic* Vol. 3). *Mugil* is one of three genera composing family in United States.



(Jordan and Evermann
1900).



Only freshwater localities are plotted

DISTRIBUTION AND HABITAT: Cape Cod, MA, to Brazil, including Bermuda, Gulf of Mexico, and West Indies. Also in eastern Pacific from Chile to Gulf of California. Postlarvae and juveniles use brackish estuaries with organically rich substrates and move into oceanic waters in fall and winter (Anderson 1957. *U.S. Fish Wildl. Serv. Fish. Bull.* 57:397-414). Seems to prefer higher salinities than *M. cephalus* (Moore 1974. *Contrib. Mar. Sci.* 18:242-55; Weinstein 1979. *Fish. Bull.* 77:339-57), but is known from hypersaline and fresh waters (Moore 1974). Adults seem most abundant near FL.

ADULT SIZE: 150 mm TL.

BIOLOGY: Prolonged offshore spawning from spring through summer. Opportunistic feeder that ingests quantities of organically rich substrate. Growth data reported by Anderson (1957); age data lacking.

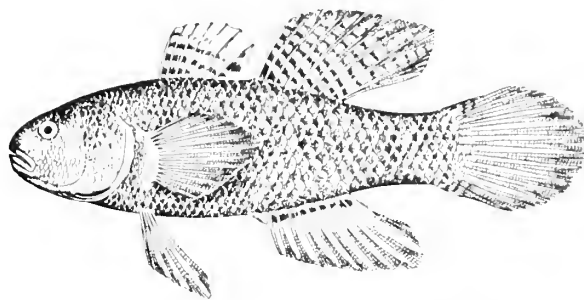
Compiler: S. W. Ross. January 1980.

Dormitator maculatus (Bloch)
Fat sleeper

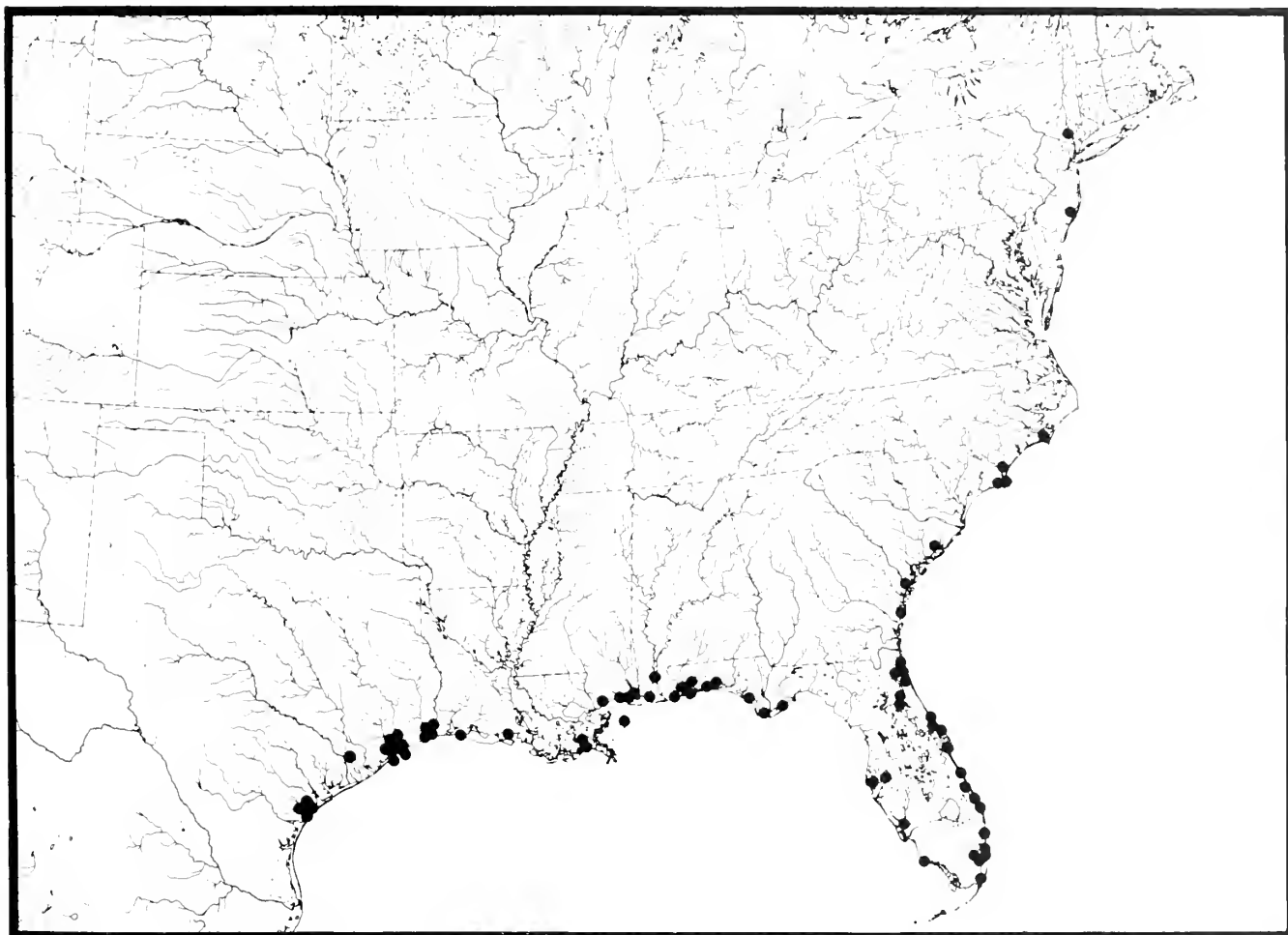
TYPE LOCALITY: Not indicated (Bloch 1792. *Naturgeschichte der Ausländischen Fische* 6: 1-126).

SYSTEMATICS: Closely related to Pacific coast geminate, *D. latifrons*.

Order Perciformes
Family Eleotridae



Puerto Rico: Hucares (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Widespread throughout fresh and brackish water coastal streams, ponds, and ditches along Atlantic and Gulf seabords, including Bahamas and West Indies to Brazil. Common where associated with abundant aquatic vegetation and organic detritus.

ADULT SIZE: 40-250 mm SL.

BIOLOGY: Hildebrand (1938. *Field Mus. Nat. Hist. Zool.* 22:219-359) described species as primarily herbivorous; Harrington and Harrington (1961. *Ecology* 42:646-66) reported diet of mosquito larvae. Mitsch (1937. *The Aquarium* 6:91-92) briefly described spawning in an aquarium. Evans et al. (1974. *J. Exp. Biol.* 61:277-83) and Evans and Mallery (1975. *J. Comp. Physiol.* 96:117-22) used *D. maculatus* to investigate sodium extrusion by a seawater-acclimated teleost.

Compiler: D. G. Lindquist. August 1978.

***Eleotris picta* Kner and
Steindachner**
Spotted sleeper

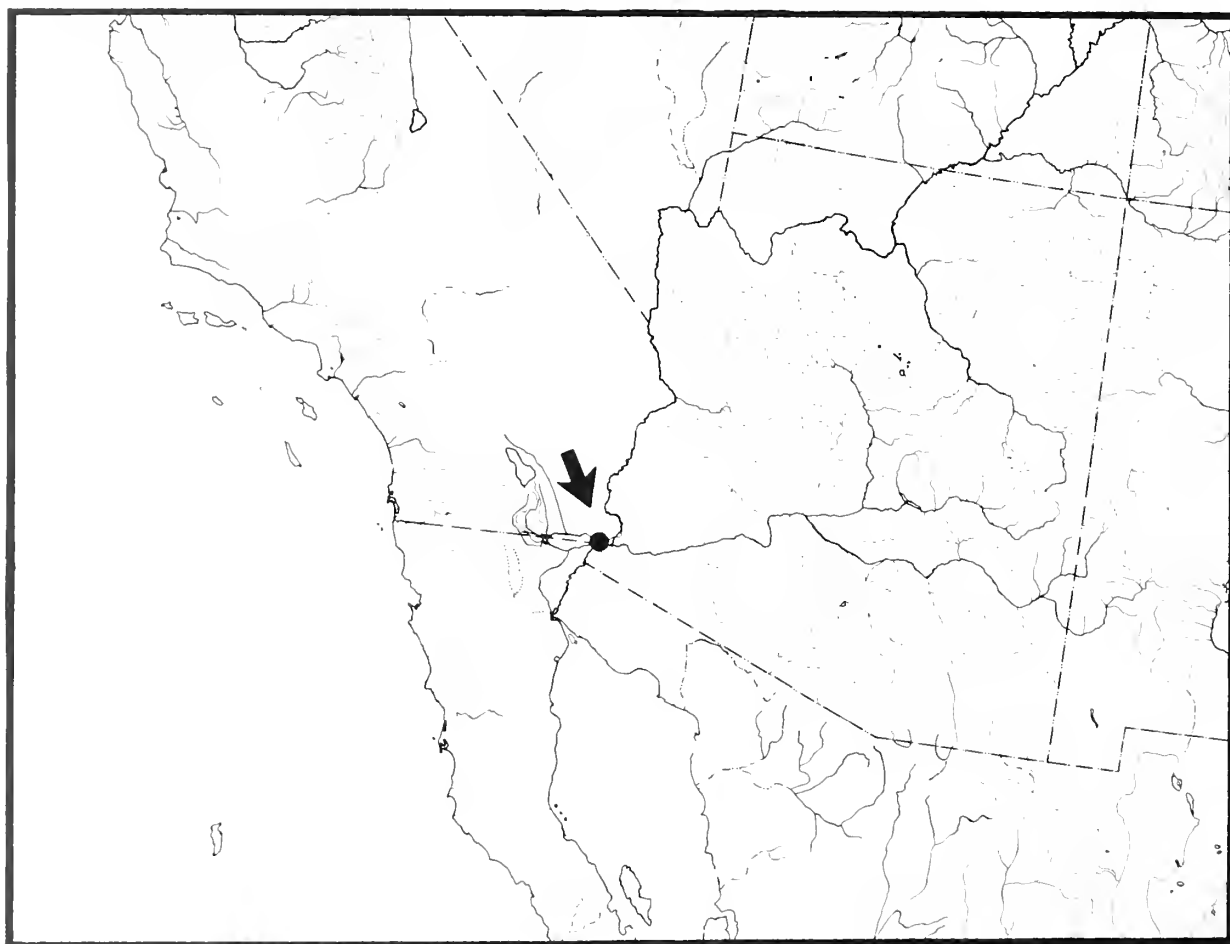
Order Perciformes
Family Eleotridae

TYPE LOCALITY: Rio Bayano, Pacific coast of Panama (Kner and Steindachner *in* Kner 1863. Bayer. Akad. Wiss. Munchen 2: 220-30).

SYSTEMATICS: Closely related to its geminate, *E. pisonis*, of Atlantic coast, and may hybridize with it in locks of Panama Canal.



Panama : Veraques, 98 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Colorado River near Winterhaven, CA. to Tumbes, Peru. Hubbs (1953. Calif. Fish Game 39: 69-76) reported single specimen from canal spillway near Colorado River. Frequents fresh and brackish water ponds, ditches, and lowland streams near coast. Abundant in streams of Sinaloa and Baja.

BIOLOGY: Zaret and Rand (1971. Ecology 52:336-42) reported on food, feeding behavior, and competition with *Gobiomorus dormitor* in Panama. Frequently described as carnivorous. Breder (1926. Zoologica 4:159-297) studied locomotion.

ADULT SIZE: 60-440 mm SL.

Compiler: D. G. Lindquist. August 1978.

***Eleotris pisonis* (Gmelin)**
Spinycheek sleeper

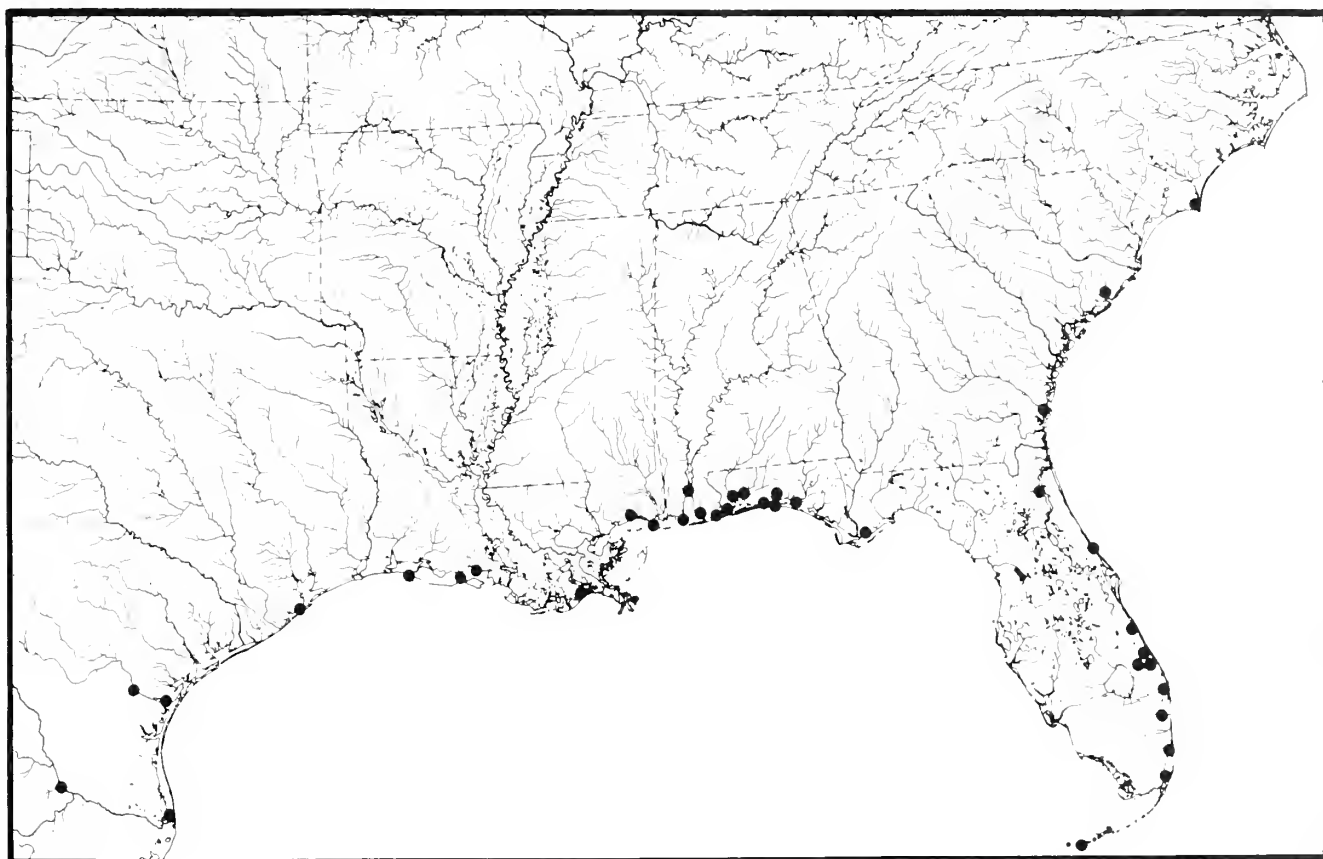
Order Perciformes
Family Eleotridae

TYPE LOCALITY: "in America australi"
[= R. Almendares, Cuba] (Gmelin in Lin-
naeus 1788. *Systema naturae*, Laurentii
Salvii, Holmiae, 13 ed., 1:1-1516).

SYSTEMATICS: Closely related to its gem-
inate, *E. picta*, of Pacific coast. Systematics
of genus in western Atlantic region poorly
understood. Uncertain whether species name
applies to northern populations. Florida spec-
imens have scale counts more or less inter-
mediate between those used to differentiate
E. amblyopsis and *E. pisonis* in western Cari-
bean.



FL: Garden Key, ca. 72 mm
SL (Jordan and Evermann
1900).



DISTRIBUTION AND HABITAT: Atlantic
and Gulf of Mexico coastal area from NC
to TX, including Bahamas and West Indies
to Brazil. Frequents muddy marshes and
ponds. Prefers low salinity upper estuaries
but may invade fresh water.

BIOLOGY: Little known. Breder (1926. Zo-
ologica 4:159-297) studied locomotion. Daw-
son (1969. Publ. Gulf Coast Res. Lab. Mus.
1:1-59) noted coloration in life.

ADULT SIZE: 50-200 mm SL.

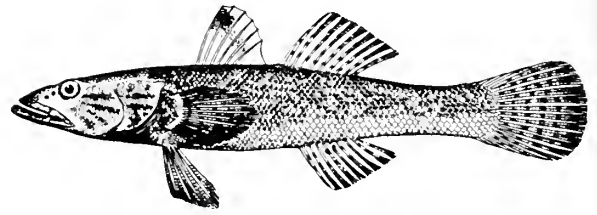
Compiler: D. G. Lindquist, August 1978.

Gobiomorus dormitor Lacepede
Bigmouth sleeper

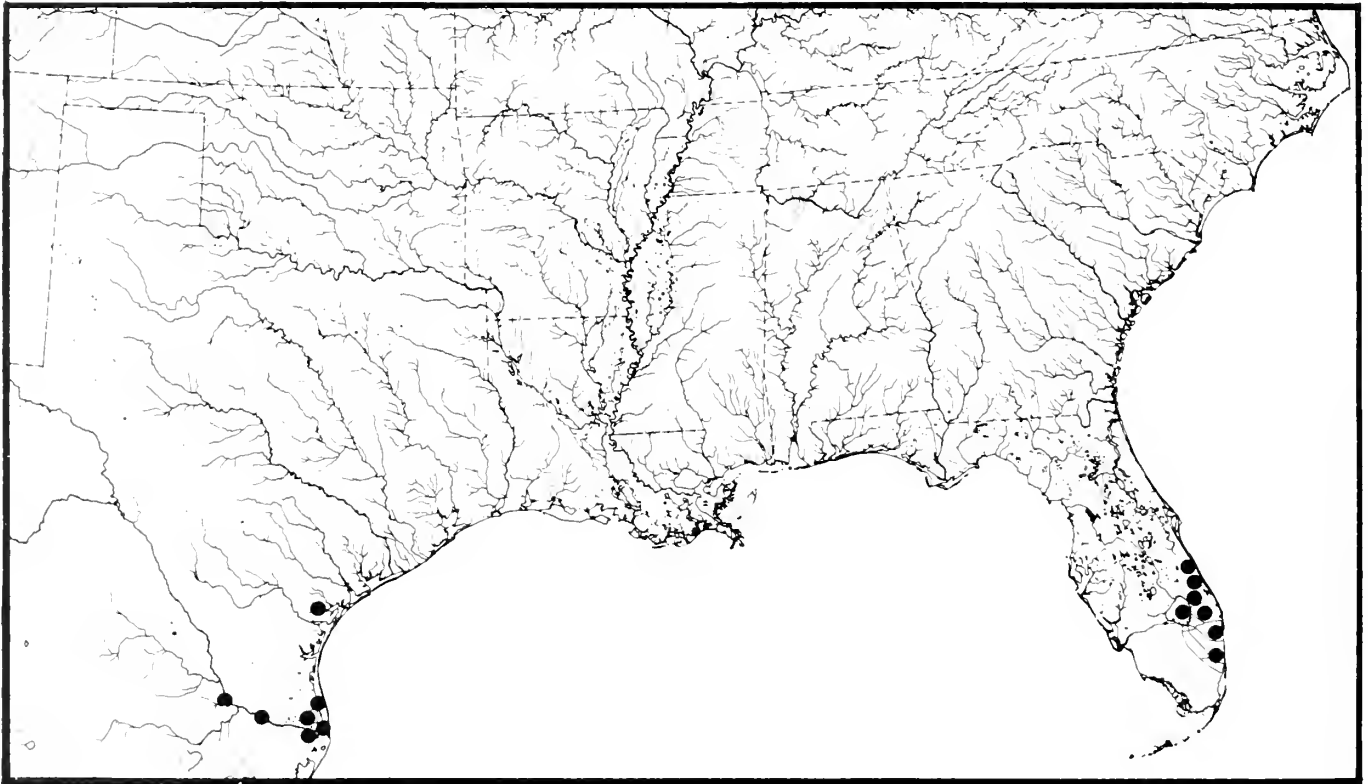
Order Perciformes
Family Eleotridae

TYPE LOCALITY: Martinique (Lacepede 1798. *Histoire Naturelle des Poissons* 2: 1-632).

SYSTEMATICS: Closely related to *G. maculatus* of Pacific slope of America, less closely to *G. polylepis* of Pacific coastal streams of Mexico. Miller (1959. *Occas. Pap. Mus. Zool. Univ. Mich.* 607:1-11) presented comparative morphometric and meristic data for the three species.



Puerto Rico: Palo Seco (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Atlantic slope of North America from southern TX, where common in Rio Grande; southern and central FL south to Guianas. Common in brackish coastal lagoons and freshwater streams entering the sea.

BIOLOGY: Largest gobioid fish. Food, feeding behavior, and competition with *Eleotris picta* in Panama reported by Zaret and Rand (1971. *Ecology* 52:336-42). Diet and reproductive season of Central American population examined by Gilbert and Kelso (1971. *Bull. Fla. State Mus. Biol. Sci.* 16:1-54). Darnell (1955. *Copeia*:237-38) noted nocturnal terrestrial habits of a Mexican population. McKay (1977. *Ecology* 58: 291-302) reported various aspects of breeding in relation to competition with and predation of cichlids in Nicaragua.

ADULT SIZE: 110-610 mm SL.

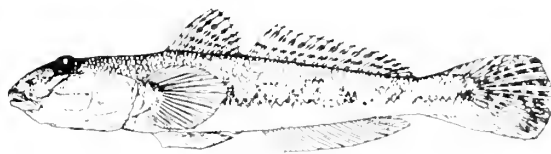
Compiler: D. G. Lindquist. August 1978.

Acanthogobius flavimanus (Temminck
and Schlegel)
Yellowfin goby

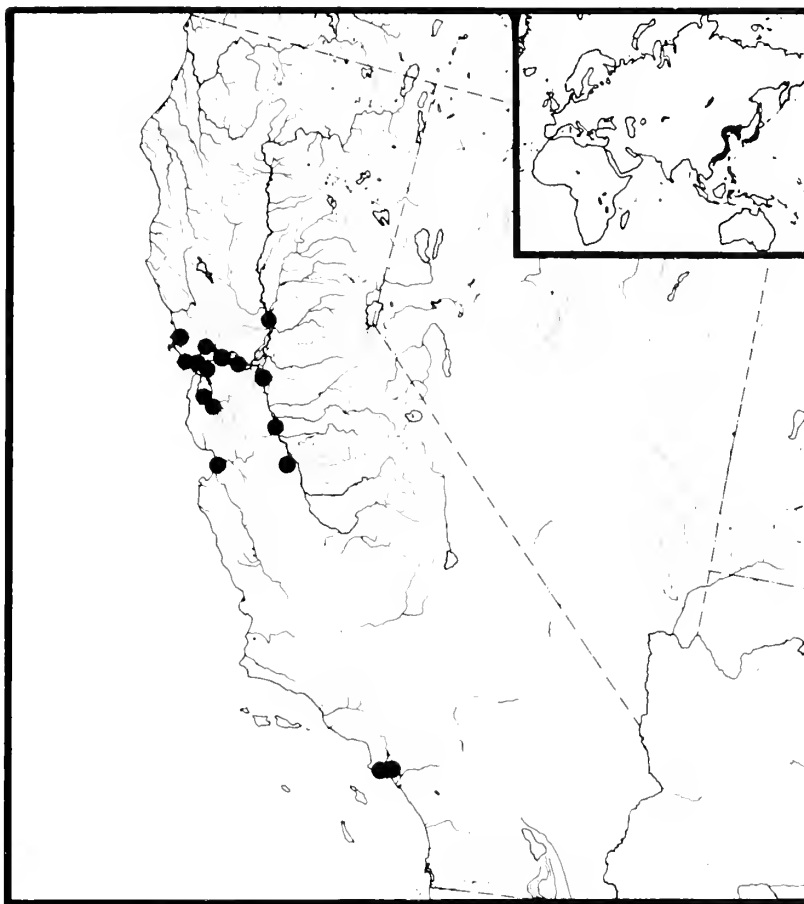
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Nagasaki Bay, Kyushu, Japan (Temminck and Schlegel 1845. *Fauna Japonica, Poissons*:1-323).

SYSTEMATICS: Only member of genus in North America. Gobiid fishes of Japan reviewed by Tomiyama (1936. *Jpn. J. Zool.* 7:37-112). Included in keys to CA fishes by Miller and Lea (1972. *Calif. Fish Game* 157:1-235) and Moyle (1976. *Inland Fishes of California*).



CA: Sacramento-San Joaquin
Delta, 12 cm SL (Moyle
1976).



DISTRIBUTION AND HABITAT: Native distribution — Japan, widely distributed and common in estuaries, ascending into streams and lakes near sea-level. Introduced from Orient and established in Sacramento-San Joaquin River Delta and Tomales Bay to San Gabriel River, CA. Not abundant but occasionally found in shallow bays, estuaries, brackish streams, and rivers.

BIOLOGY: Aspects of introduced population reported by Brittan et al. (1963. *Calif. Fish Game* 49:302-04; 1970. *Proc. Calif. Acad. Sci.* 38:207-14). Moyle (1976) provided a summary of California populations. Miyazaki (1940. *Bull. Jap. Soc. Fish. Tokyo* 9:159-80) studied seasonal distribution, reproductive season, and diet. Dotu and Mito (1955. *Jap. J. Ichthy.* 4:153-61) reported on breeding habits, larvae, and young. Okada (1961. *Studies on the Freshwater Fishes of Japan*) and Kawababe et al. (1968. *Spec. Publ. Seto Mar. Biol. Lab.* 2:45-73) provided summaries of Japanese investigations.

ADULT SIZE: 60-230 mm SL.

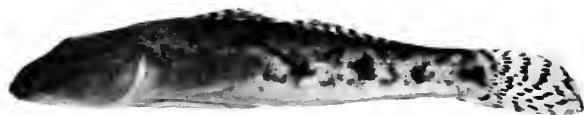
Compiler: D. G. Lindquist. February 1979.

Awaous tajasica (Lichtenstein)
River goby

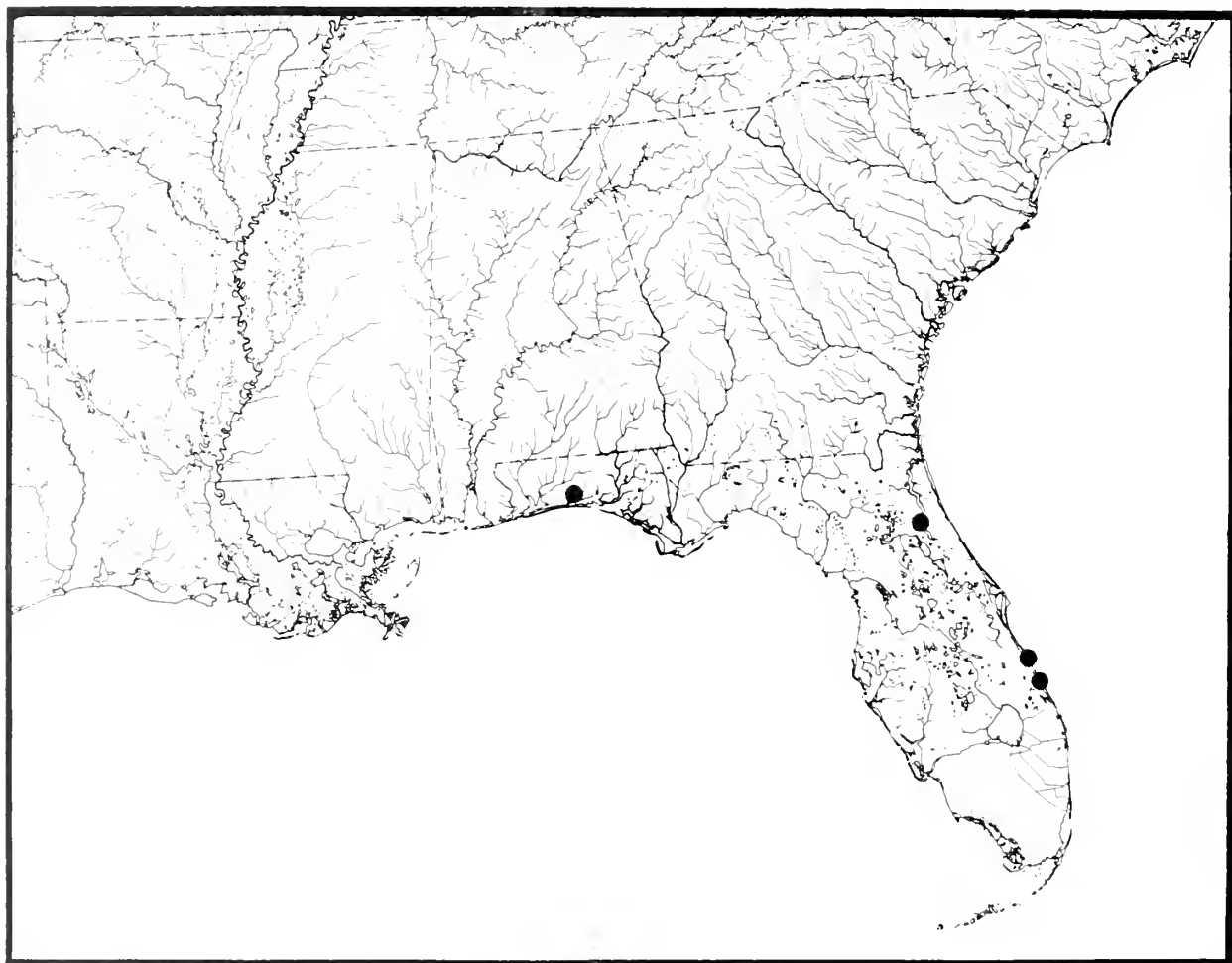
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Brazil (Lichtenstein 1822. Abh. Preuss. Akad. Wiss. 1-273).

SYSTEMATICS: Closely related to *A. trans-andeanus* of Pacific coast.



Panama Canal Zone, 84 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Atlantic and Gulf coasts of FL, from St. John's River to Brazil, but primarily West Indies and Caribbean coast of Central America. Rare in small to large streams of FL with clear water, slow to moderate current, sandy or hard mud bottom, and little or no vegetation (Yerger in Gilbert 1978. *Rare and Endangered Biota of Florida* 4:1-58). Common in other parts of range in freshwater creeks, streams, rivers, lakes; also enters brackish and ocean waters.

ADULT SIZE: 60-300 mm SL.

BIOLOGY: Little known. Yerger (in Gilbert 1978) discussed presumed life history aspects of FL populations.

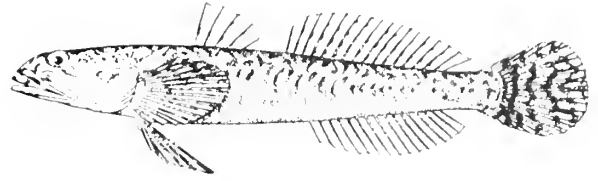
Compiler: D. G. Lindquist. June 1979.

***Clevelandia ios* (Jordan and Gilbert)**
Arrow goby

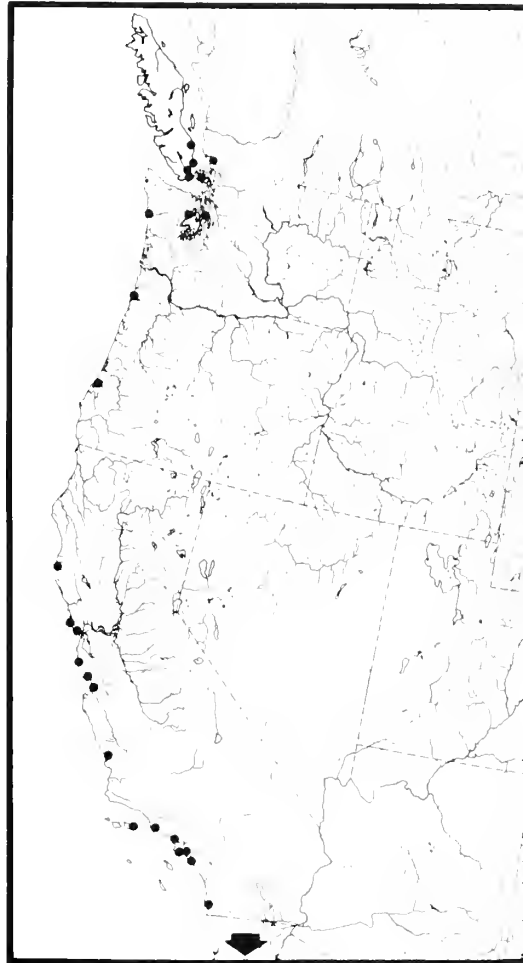
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Saanich Arm, on the eastern shore of Vancouver Island, BC (Jordan and Gilbert 1883. Proc. U.S. Natl. Mus. [1882] 5: 437-38).

SYSTEMATICS: Monotypic genus, closely allied to *Gillichthys* (Jordan and Evermann 1898. U.S. Natl. Mus. Bull. 47:1-3136). Prasad (1958. Am. Midl. Nat. 59: 465-76) presented racial analysis of CA populations.



WA: Elliott Bay, near Seattle, ca. 42 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Gulf of California and Magdalena Bay, Baja California, to Vancouver Island, BC. Abundant in shallows of sheltered bays, estuaries, lagoons, and tidal sloughs. Burrows into sand or mud at low tide, often sheltered with commensal shrimps or worms.

ADULT SIZE: 29-55 mm SL.

BIOLOGY: MacGinitie (1935. Am. Midl. Nat. 16:629-765) and Prasad (1958; 1959. Proc. Natl. Inst. Sci. India 24B: 314-24, 25B: 12-30) reported on bionomics, habitat, and reproduction (including embryonic and larval development) of Elkhorn Slough, Monterey Bay, CA, population. Macdonald (1975. Calif. Dept. Fish Game Fish Bull. 165:117-21) presented life history notes on Anaheim Bay, CA, population. Overall summary in Hart (1973. *Pacific Fishes of Canada*).

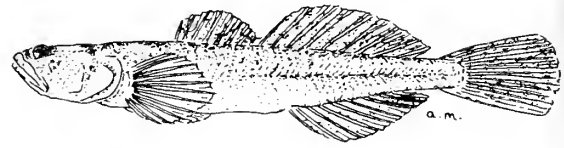
Compiler: D. G. Lindquist. June 1979.

Eucyclogobius newberryi (Girard)
Tidewater goby

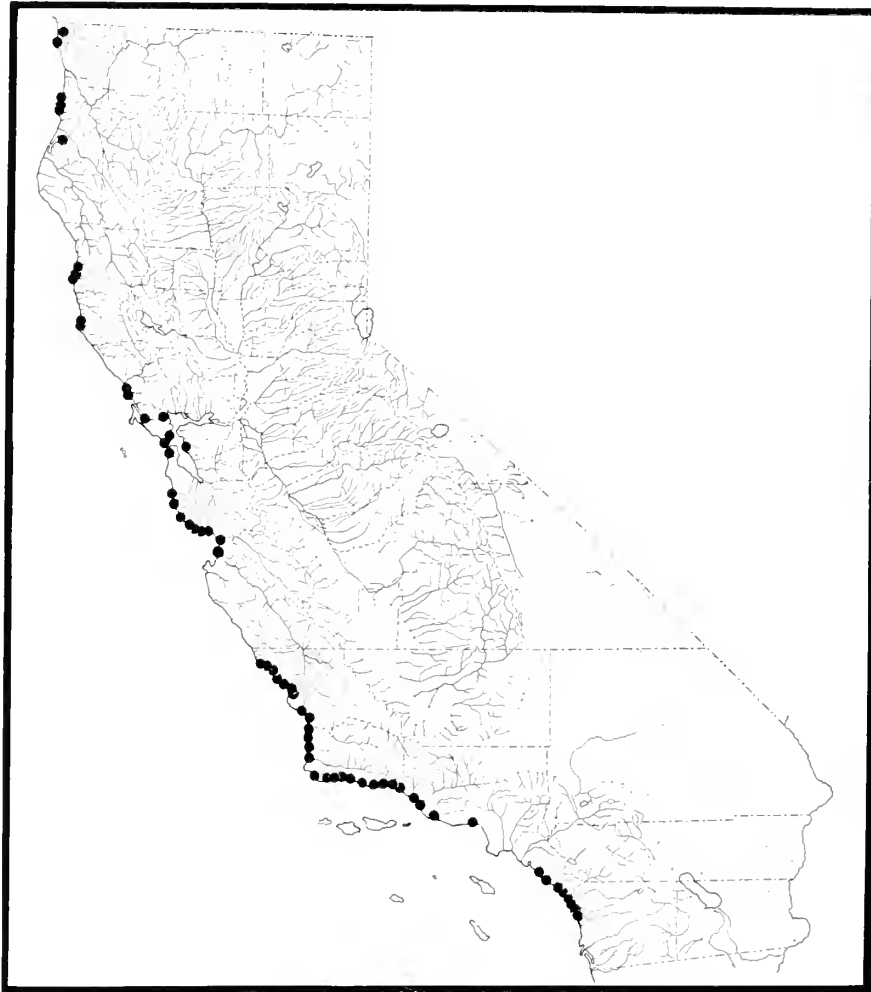
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Tomales Bay, Marin Co., CA (Girard 1854. Proc. Acad. Nat. Sci. Phila. [1854-55] 8:129-40).

SYSTEMATICS: One of several eastern Pacific gobies grouped under generic name *Lepidogobius* by some workers (Ginsburg 1945. Copeia:133-42).



CA: San Luis Obispo Co., San Luis Obispo Creek, 45 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Mouth of Smith River, Del Norte Co., CA, south to Agua Hedionda Lagoon, San Diego Co., CA. Restricted mostly to small coastal lagoons and near stream mouths in uppermost brackish portions of larger bays (Moyle 1976. *Inland Fishes of California*; Swift et al. unpubl.).

BIOLOGY: Benthic; prefers brackish or fresh water. Spawns April to June in southern CA at 15.5-18.3°C. Annual; may live into third summer to the north. Male digs nest burrow vertically, 100-200 mm into sand in water 25-40 cm deep; eggs guarded. Diet small crustaceans, insects, and molluscs gleaned from substrate (Swift et al. unpubl.).

ADULT SIZE: 35-50 mm TL.

Compiler: C. C. Swift. January 1979.

Gillichthys mirabilis Cooper
Longjaw mudsucker

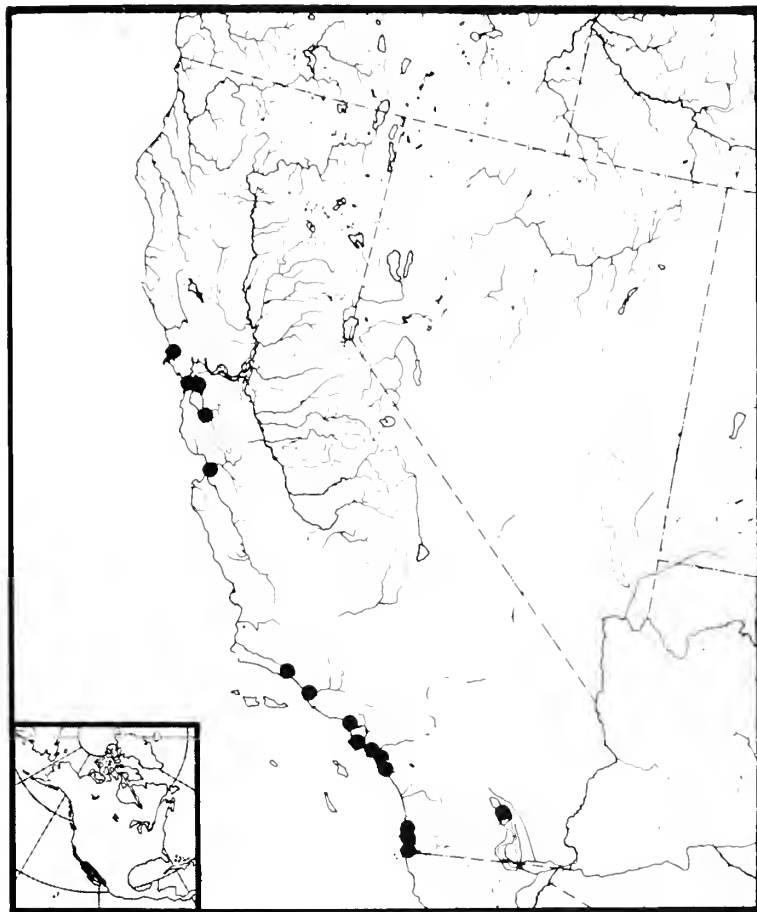
Order Perciformes
Family Gobiidae

TYPE LOCALITY: San Diego Bay, CA
(Cooper 1863. Proc. Calif. Acad. Sci. 3:109-14).

SYSTEMATICS: Closely allied to only other member of genus, *G. seta*, probably a neotenic derivative of *G. mirabilis* (Barlow 1961. Copeia:423-37; 1963. Pac. Sci. 17:47-72). Chen and Ebeling (1971. Copeia: 171-74) karyotyped both species.



CA: 98 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Tomales Bay, CA, to Magdalena Bay, Baja California and Gulf of California from Mulege, Baja California to Bahia Agiabampo, Sinaloa, Mexico. Introduced into Salton Sea, CA. Common in shallows of bays and estuaries where it burrows into mudflats.

ADULT SIZE: 60-200 mm SL.

BIOLOGY: Wiesel (1947. Copeia:77-85; 1949. Copeia:101-10) presented information on breeding behavior and reproduction. Habits of Salton Sea population discussed by Walker et al. (1961. Calif. Fish. Game Fish Bull. 113:88-91). Noble and King (1960. J. Parasitol. 46:679-85) and Noble et al. (1963. Ecology 44:295-305) reported ecological aspects relevant to parasitic nematodes. De Vlaming (1972. Copeia:278-91) analyzed reproductive cycling. Todd (1968. Copeia: 192-94) and Todd and Ebeling (1966. Bio. Bull. 13:265-88) reported terrestrial habits. Overall summary in Moyle (1976. *Inland Fishes of California*).

Compiler: D. G. Lindquist. February 1979.

***Gobioides broussoneti* Lacepede**
Violet goby

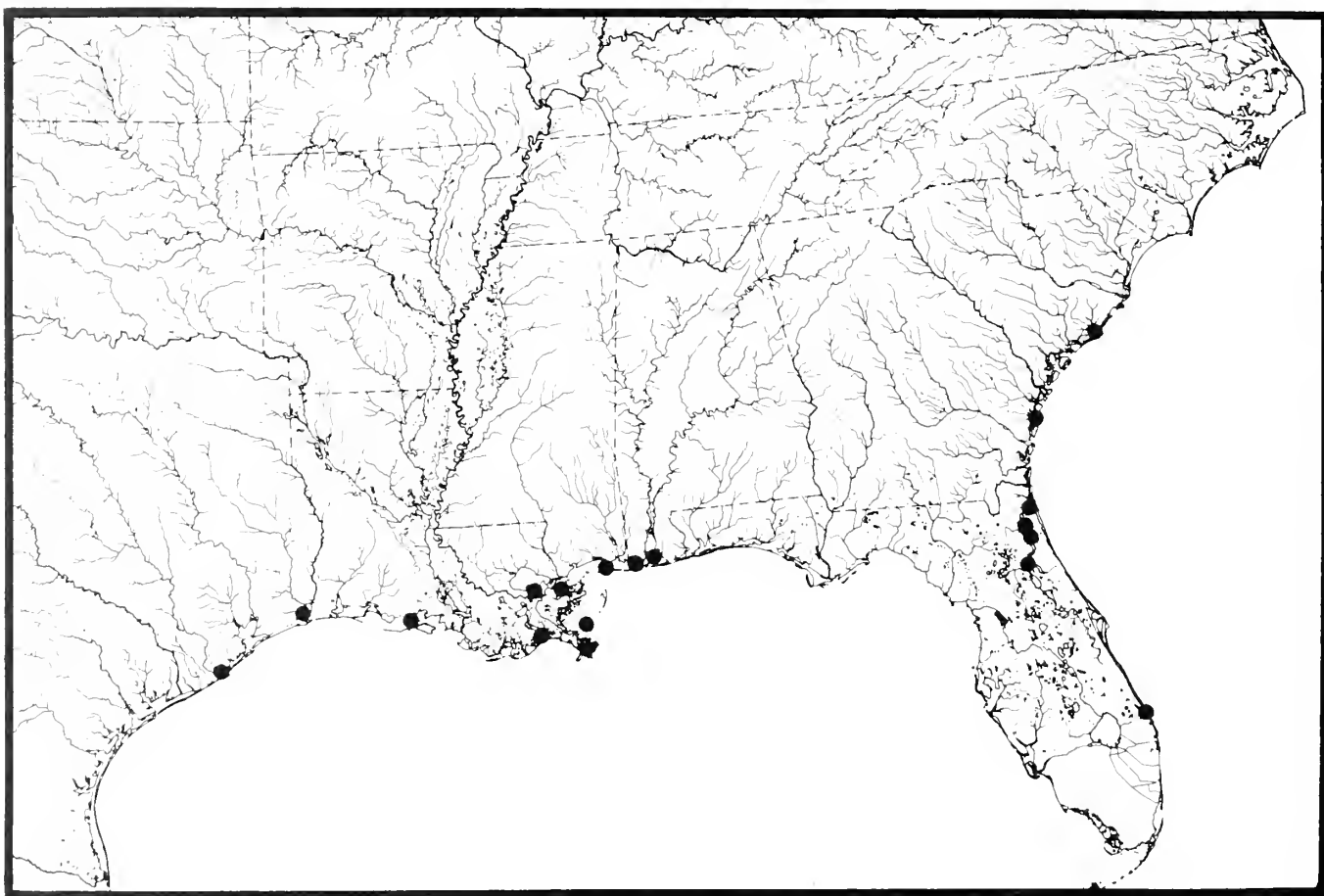
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Surinam? (Lacepede 1798. *Histoire Naturelle des Poissons* 2:1-632).

SYSTEMATICS: Placed by some in separate family, Gobioididae (Greenwood et al. 1966. Bull. Am. Mus. Nat. Hist [1965-66] 131:341-455; Nelson 1976. *Fishes of the World*). Miller (1973. J. Zool. Lond. 171:397-434) preferred placement within subfamily Gobionellinae (Gobiidae). Palmer (1952. Ann. Mag. Nat. Hist. 12:50-57) reviewed genus. Dawson (1969. Pub. Gulf Coast Res. Lab. Mus. 1:1-59) provided description of species.



FL: Putnam Co., St. Johns
River at Welaka (NCSM).



DISTRIBUTION AND HABITAT: Atlantic and Gulf coasts from Charleston, SC, to Rio de Janeiro, Brazil. Sporadic occurrences in low salinity, muddy marsh habitats, ascending rivers, and from offshore sand-bottom habitats.

ADULT SIZE: 65-550 mm SL.

BIOLOGY: No information.

Compiler: D. G. Lindquist. June 1979.

Gobionellus atripinnis Gilbert and
Randall
Blackfin goby

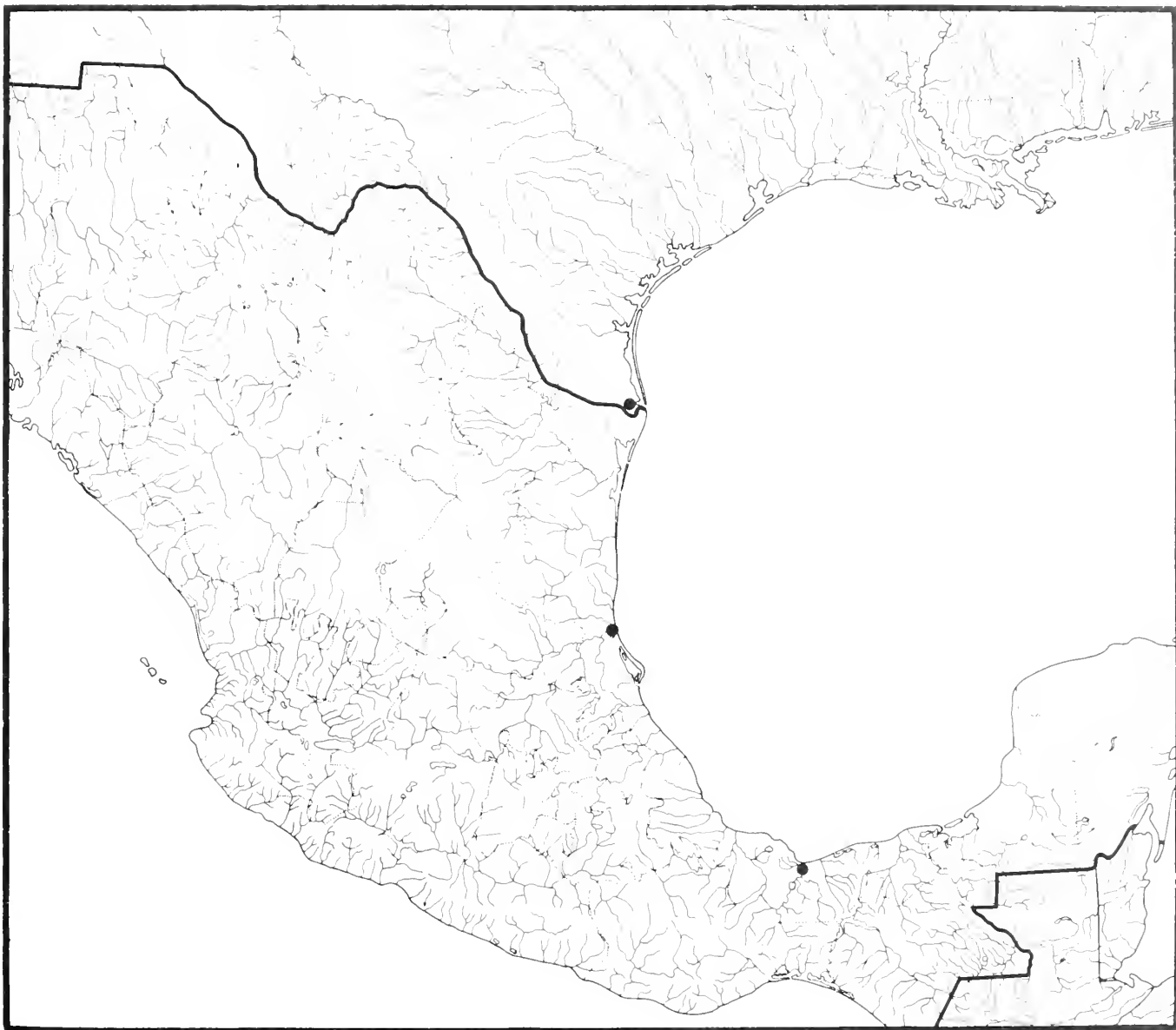
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Stream, 12.4 km e of Brownsville, TX, on state route 4 (Gilbert and Randall 1979. Northeast Gulf Sci. 3: 27-47).

SYSTEMATICS: Gilbert and Randall (1979) noted that *G. atripinnis* shares certain external morphological features with *G. holcosoma*, but subsequent unpublished studies indicate a very close relationship to *G. shufeldti*.



Holotype, male, 40 mm SL (Gilbert and Randall 1979.).



DISTRIBUTION AND HABITAT: Apparently confined to extreme western Gulf of Mexico, where it ranges from extreme southern TX to Veracruz, Mexico. Occurs both in brackish and freshwater habitats, with most records to date coming from coastal freshwater streams.

ADULT SIZE: up to 44.3 mm SL.

BIOLOGY: No information available.

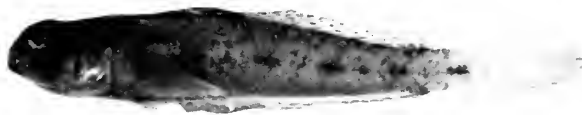
Compiler: C. R. Gilbert. December 1979.

Gobionellus boleosoma (Jordan and
Gilbert)
Darter goby

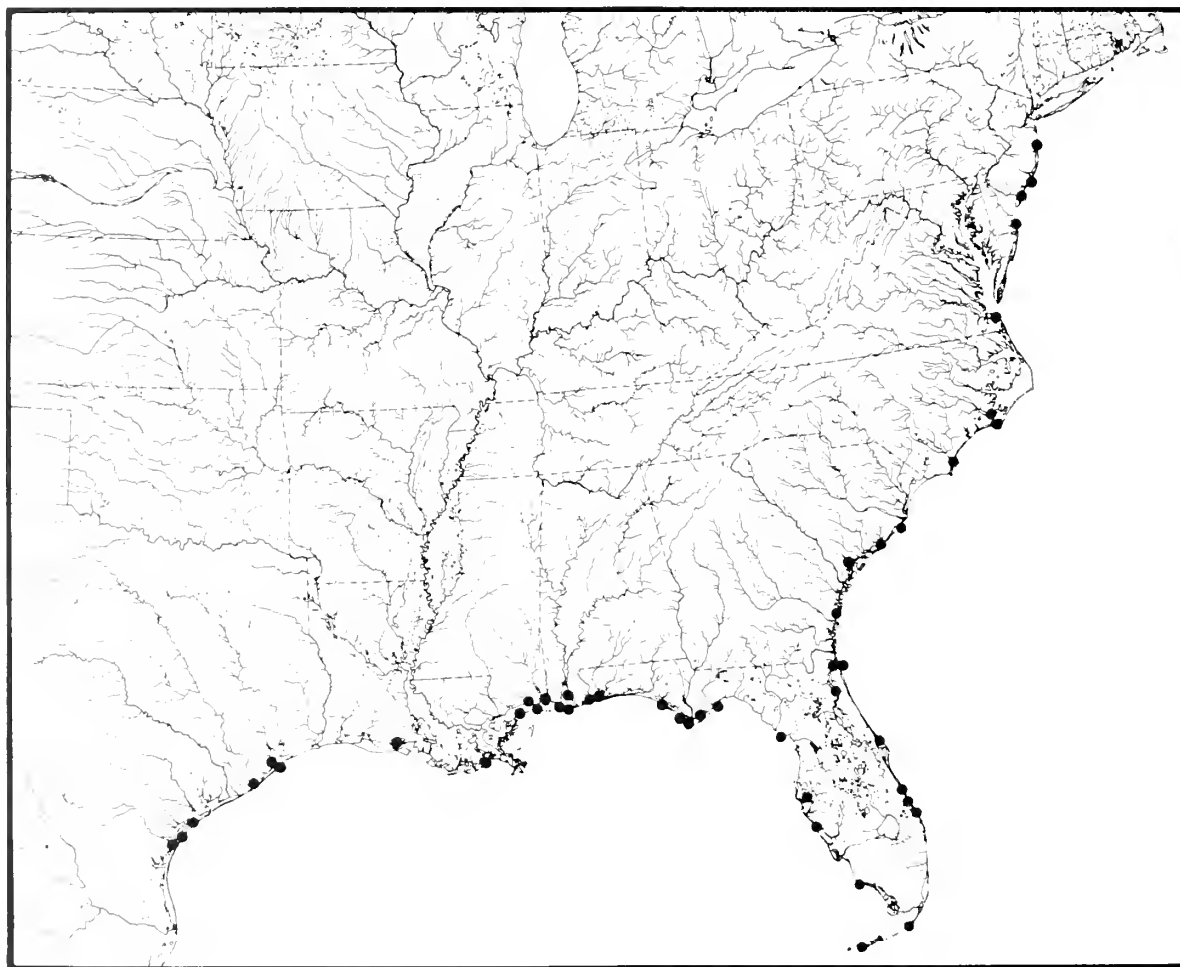
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Laguna Grande, Pensacola, FL (Jordan and Gilbert 1883. Proc. U.S. Natl. Mus. [1882] 5:241-307).

SYSTEMATICS: Miller (1973. J. Zool. Lond. 171:397-434) placed in subfamily Gobionellinae. Ginsburg (1932. Bull. Bingham Oceanog. Collect. Yale Univ. 4:1-51) reviewed genus. Gilbert and Randall (in press. Northeast Gulf Sci.) provides key to this and related species.



TX: Aransas Co., St. Joseph, 30 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Atlantic coast, Gulf of Mexico, and Caribbean (throughout Bahamas and West Indies), from Manasquan Inlet, NJ, to Brazil. Abundant and widely distributed over broad salinity range. Most common in lower estuaries and sounds over muddy bottoms.

ADULT SIZE: 18-62 mm SL.

BIOLOGY: Kuntz (1916. Bull. U.S. Bur. Fish. [1914] 34:407-30) and Hildebrand and Cable (1940. Bull. U.S. Bur. Fish. [1933-38] 48:505-642) described and illustrated eggs, larvae, and juvenile stages. Summaries in Dawson (1969. Publ. Gulf Coast Res. Lab. Mus. 1:1-59) and Fritzsche (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 5).

Compiler: D. G. Lindquist. June 1979.

Gobionellus pseudofasciatus Gilbert
and Randall
Slashcheek goby

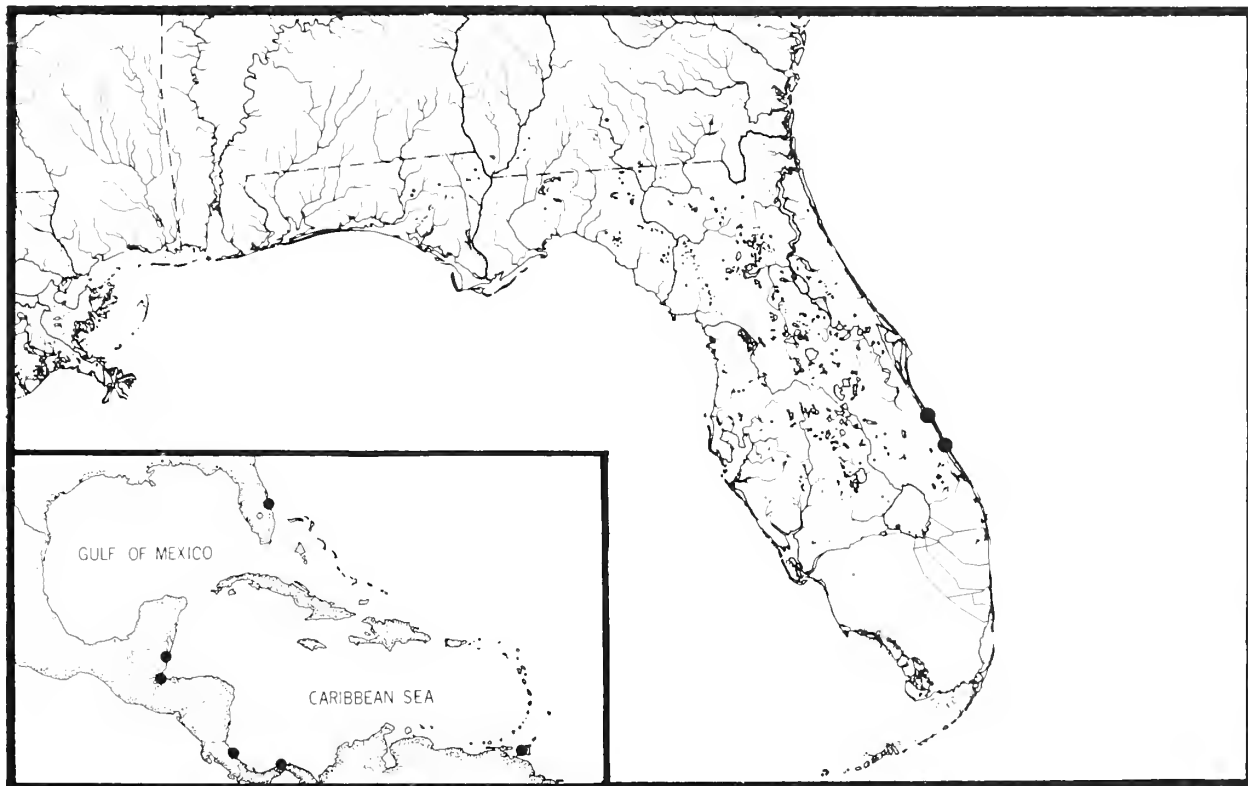
Order Perciformes
Family Gobiidae

TYPE LOCALITY: West side of Tortuguero Lagoon, just below point across from Tortuguero Village, Limon Province, Costa Rica (Gilbert and Randall *in* Gilbert and Kelso 1971. Bull. Fla. State Mus. Biol. Sci. 16: 1-54).

SYSTEMATICS: Hastings (1979. Northeast Gulf Sci. [1978] 2:140-44) documented pigment variation in a FL population. Gilbert and Randall (1979. Northeast Gulf Sci. 3: 27-47) included species in key to coarse-scaled *Gobionellus* spp.



FL: Brevard Co., Sebastian Creek, female, 34 mm SL (Hastings 1979).



DISTRIBUTION AND HABITAT: Coastal brackish to freshwater streams of South and Central America (Trinidad to Belize), with disjunct population in fresh and brackish water in east-central FL (Indian River and Brevard cos.). Inhabits open sand or mud bottoms with some detritus.

ADULT SIZE: 53 mm SL maximum.

BIOLOGY: Nothing known.

Compiler: P. A. Hastings. November 1979.

Gobionellus shufeldti (Jordan and
Eigenmann)
Freshwater goby

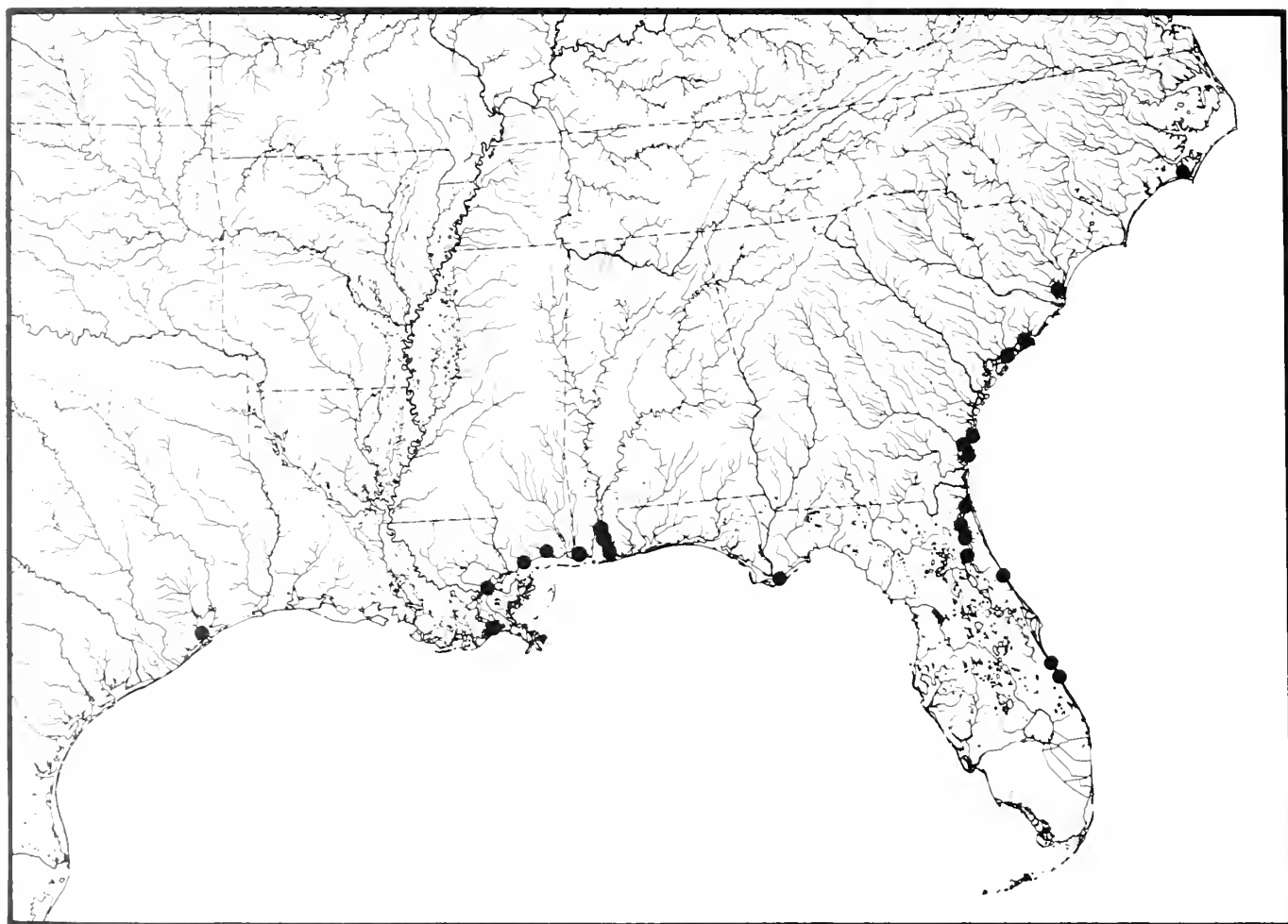
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Gulf coast of United States, vicinity of New Orleans, LA (Jordan and Eigenmann 1887. Proc. U.S. Natl. Mus. [1886] 9: 477-518).

SYSTEMATICS: Miller (1973. J. Zool. Lond. 171:397-434) placed genus in subfamily Gobionellinae. Ginsburg (1932. Bull. Bingham Oceanog. Collect. Yale Univ. 4:1-51) reviewed systematics of this and other species. Gilbert and Randall (in press. North-east Gulf Sci.) provided key to freshwater gobies of United States.



FL: Clay Co., Doctor's Lake, 27
mm SL (NCSM).



DISTRIBUTION AND HABITAT: Atlantic coast and Gulf of Mexico from Newport River, NC, to Galveston Bay, TX, Venezuela and Brazil. Atlantic and Gulf Coast populations apparently disjunct. Prefers low salinity marshes and upper estuaries; can be common at times. Occasionally in open bays and sounds.

ADULT SIZE: 25-67 mm SL.

BIOLOGY: No information. Dawson (1969. Publ. Gulf Coast Res. Lab. Mus. 1:1-59) provided description and remarks.

Compiler: D. G. Lindquist, June 1979.

Gobiosoma bosci (Lacepede)
Naked goby

Order Perciformes
Family Gobiidae

TYPE LOCALITY: Charleston, SC (Lacepede 1800. *Histoire Naturelle des Poissons* 2:1-632).

SYSTEMATICS: Subgenus *Gobiosoma*. Closest relatives are *G. ginsburgi* and *G. longipala*. Ginsburg (1933. *Bull. Bingham Oceanogr. Coll.* 4:1-59) revised genus; Böhlke and Robins (1968. *Proc. Acad. Nat. Sci. Phila.* 120:45-175) refined generic classification.



VA: Gloucester Co., York River, Gloucester Point, 43 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Atlantic coast and Gulf of Mexico from Cape Cod, MA, to Campeche, Mexico. Seldom abundant but widespread in low to moderate salinity. Associated with patches of oysters or grass flats on sand and mud bottom estuaries. Enters fresh water to greater extent than *G. robustum*.

ADULT SIZE: 23-58 mm SL.

BIOLOGY: Hoese (1966. *Publ. Inst. Mar. Sci. Univ. Tex.* 11:7-11) analyzed habitat selection, and Hoese and Hoese (1967. *Tulane Stud. Zool.* 14:55-62) induced feeding reaction. Dawson (1966. *Am. Midl.*

Nat. 76:379-409) reported abundance, seasonal occurrence, growth rate, ecology, interspecific relationships, meristics, and body proportions. Dahlberg and Conyers (1973. *Fish. Bull.* 71:279-87) studied ecological relationships. Eggs, larvae, and young described by Hildebrand and Cable (1938. *Bull. U.S. Bur. Fish.* 48:505-642). Summaries in Dawson (1969. *Publ. Gulf. Coast Res. Lab. Mus.* 1:1-59), Fritzsche (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 5), and Hildebrand and Schroeder (1928. *Fishes of Chesapeake Bay*).

Compiler: D. G. Lindquist. February 1979.

Gobiosoma robustum Ginsburg
Code goby

Order Perciformes
Family Gobiidae

TYPE LOCALITY: Corpus Christi, TX
(Ginsburg 1933a. Proc. U.S. Natl. Mus.
82:1-23).

SYSTEMATICS: Subgenus *Garmannia*,
with *G. nudum*, *G. hildebrandi*, *G. spes*,
and *G. schultzi*. Ginsburg (1933b. Bull.
Bingham Oceanogr. Coll. 4:1-59) revised
genus; Böhlke and Robins (1968. Proc.
Acad. Nat. Sci. Phila. 120:45-174) refined
generic classification.



FL: Charlotte Co., Cape Haze
Marine Laboratory, 31 mm SL
(NCSM).



DISTRIBUTION AND HABITAT: Atlantic coast and Gulf of Mexico from Martha's Vineyard, MA, to Yucatan, Mexico. Abundant in moderate to high salinity, especially on sandy bottoms with covering vegetation such as mangrove roots or grasses (*Thalassia*).

ADULT SIZE: 13-45 mm SL.

BIOLOGY: Breder (1942. Zoologica 27:61-65) described reproduction. Hoese (1966. Publ. Inst. Mar. Sci. Univ. Tex. 11:7-11) analyzed habitat segregation. Springer and Woodburn (1960. Fla. State Board

Cons. Prof. Pap. Ser. 1:1-104) discussed biology, and Springer and McErlean (1961. Tulane Stud. Zool. 9:87-98) reported spawning cycle and growth in Tampa Bay. Dawson (1966. Am. Midl. Nat. 76:379-409) investigated abundance, seasonal occurrence, growth, ecology, interspecific relationships, meristics, and body proportions. Summaries in Dawson (1969. Publ. Gulf Coast Res. Lab. Mus. 1:1-59) and Fritzsche (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 5).

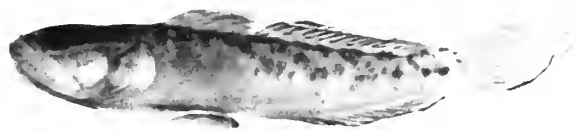
Compiler: D. G. Lindquist. February 1979.

Microgobius gulosus (Girard)
Clown goby

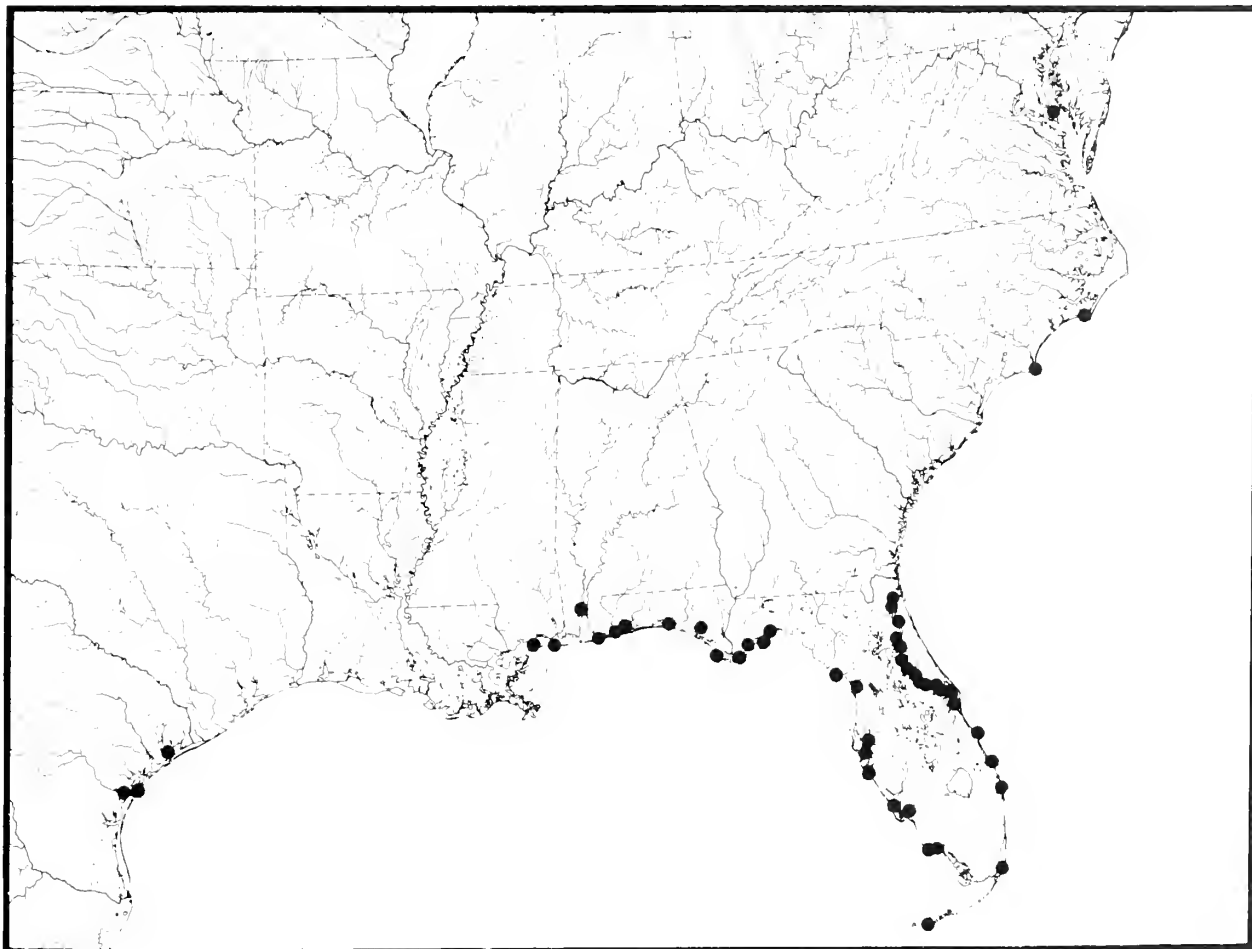
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Indianola, TX (Girard 1859. Proc. Acad. Nat. Sci. Phila. [1858] 10:167-71).

SYSTEMATICS: Genus in tribe Gobiosomini (seven-spined gobiids), closely allied to *Parrella* and *Bollmannia* (Birdsong 1975. Bull. Fla. State Mus. Biol. Sci. 19:135-87). Relationships of *Microgobius* species unclear.



FL: Charlotte Co., Cape Haze, Marine Lab. 46 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Atlantic coast, from Chesapeake Bay and Gulf of Mexico to Corpus Christi, TX. Relatively common on Gulf coast, occurring most frequently in muddy, estuarine habitats associated with aquatic vegetation. Also common on shell and muck bottom in TX. Fresh water records primarily restricted to St. Johns River in FL.

BIOLOGY: Baird (1965. Publ. Inst. Mar. Sci. Univ. Tex. 10:1-8) described aggressive behavior, sexual dimorphism, and niche. Dawson (1969. Publ. Gulf Coast Res. Lab. Mus.:1-60) and Fritzsche (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 5) provided summaries.

ADULT SIZE: 35-72 mm SL.

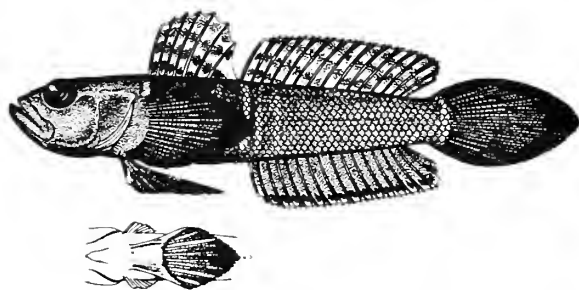
Compiler: D. G. Lindquist. February 1979.

Microgobius thalassinus (Jordan and Gilbert)
Green goby

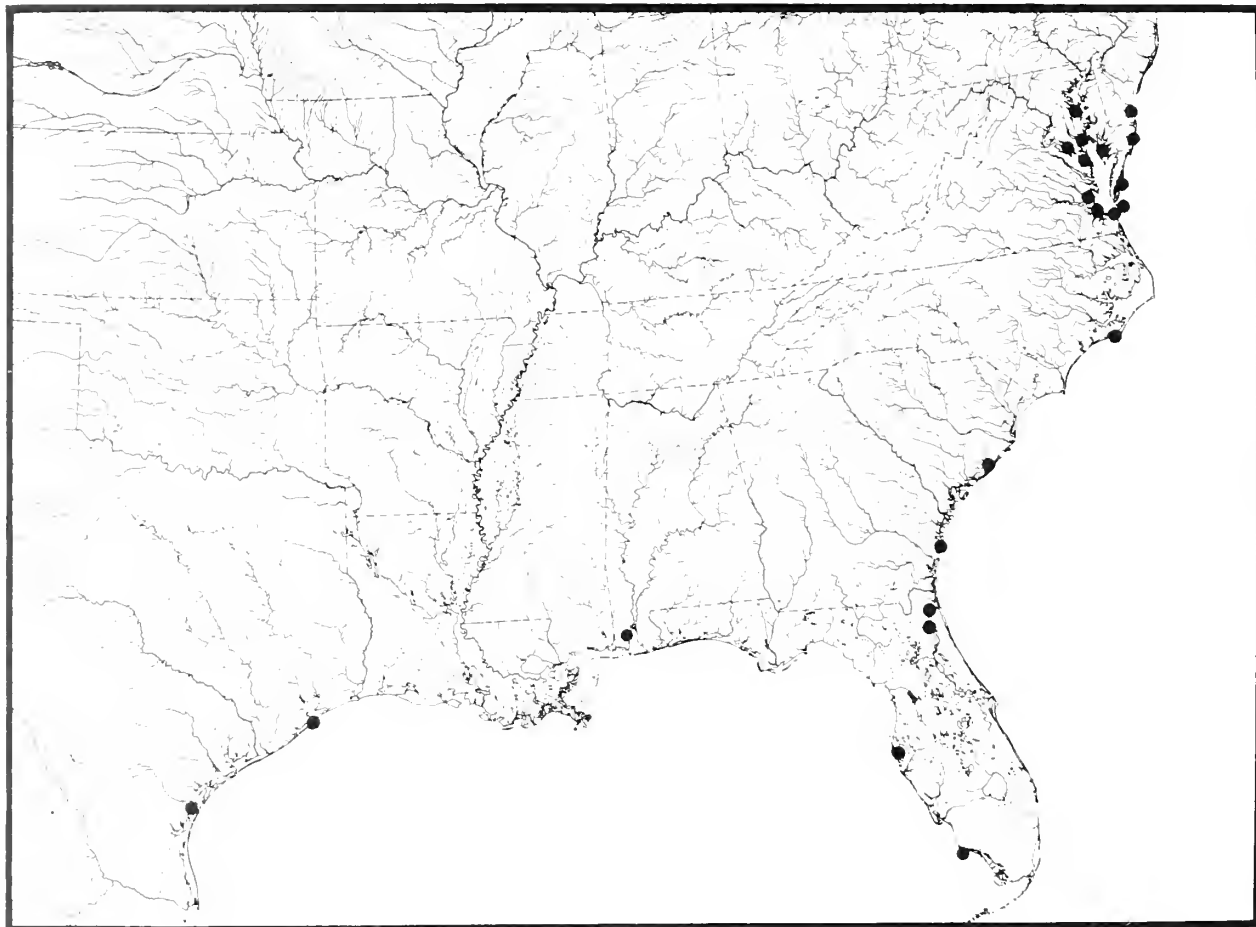
Order Perciformes
Family Gobiidae

TYPE LOCALITY: Charleston, SC (Jordan and Gilbert 1883. Proc. U.S. Natl. Mus. [1882] 5:580-620).

SYSTEMATICS: Tribe Gobiosomini (seven-spined gobiids), closely allied to *Parrella* and *Bollmannia* (Birdsong 1975. Bull. Fla. State Mus. Biol. Sci. 19:135-87). Relationships of *Microgobius* species unclear.



(Smith 1907. *The Fishes of North Carolina*)



DISTRIBUTION AND HABITAT: Atlantic coast and Gulf of Mexico, from Chesapeake Bay and DE to Corpus Christi, TX. Relatively uncommon. Occurs on sandy bottoms along Gulf coast, and on mud and oyster bottom or in dense growth of sponge in Chesapeake Bay. Reported from fresh water of St. Johns River, FL, by Tagatz (1968. Q. J. Fla. Acad. Sci. [1967] 30:25-50), but enters such water much less often than *M. gulosus* and does not range nearly as far upstream.

ADULT SIZE: 35-50 mm SL.

BIOLOGY: Schwartz (1971. Chesapeake Sci. 12:156-66) reported details of habitat, meristics, color, and distribution of Chesapeake Bay population. Hildebrand and Cable (1938. Bull. U.S. Bur. Fish. 48:505-642) discussed spawning, larvae, juveniles, distribution of young stages, and growth. Smith (1907. *The Fishes of North Carolina*), Hildebrand and Schroeder (1928. *Fishes of Chesapeake Bay*), Dawson (1969. Publ. Gulf Coast Res. Lab. Mus:1-60), and Fritzsche (1978. *Development of Fishes of the Mid-Atlantic Bight* Vol. 5) provided summaries.

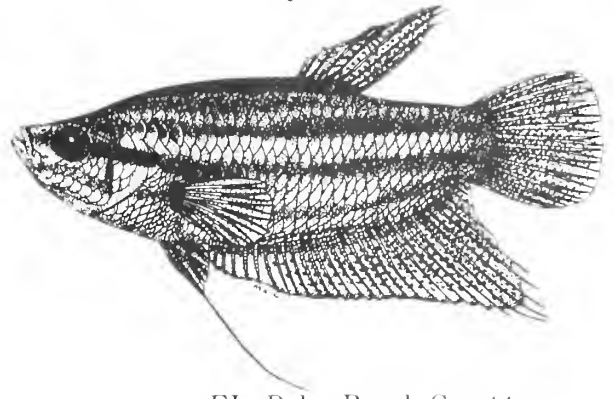
Compiler: D. G. Lindquist. February 1979.

Trichopsis vittatus (Kuhl and
van Hasselt)
Croaking gourami

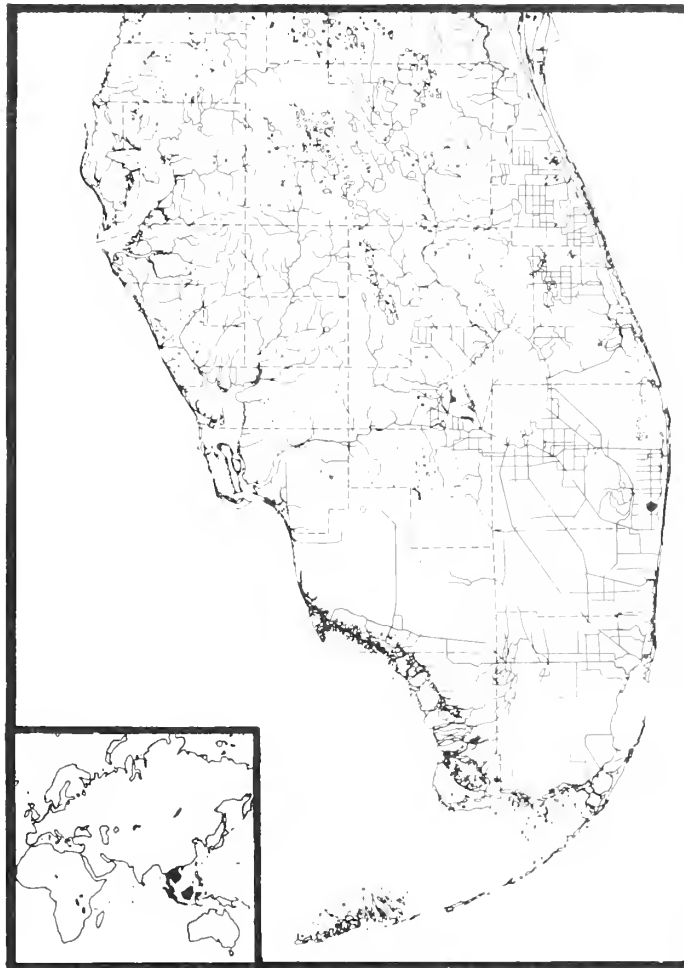
Order Perciformes
Family Belontiidae

TYPE LOCALITY: Java (Kuhl and van Hasselt in Cuvier and Valenciennes 1831. *Histoire Naturelle des Poissons* Vol. 7:1-531).

SYSTEMATICS: In subfamily Macro-podinae (Liem 1963. *Ill. Biol. Monogr.* 31: 1-149). Two to four species in the genus (Liem 1965. *Copeia*:206-13; and Goldstein 1971. *Anabantoids: Gouramis and Related Fishes*).



FL: Palm Beach Co., 44 mm
SL (FAU).



DISTRIBUTION AND HABITAT: Native distribution — Small weedy streams in Java, Borneo, Sumatra, Malaya, Indo-China, and Thailand. Established population was recently (1978) found in canal system in Palm Beach Co., FL; occurs only in restricted area and is not abundant. Can live in waters with low oxygen content due to aerial respiration through accessory respiratory (labyrinth) organ. Introduction probably due to releases of home aquarium fish.

ADULT SIZE: 35-42 mm SL, 65 mm SL maximum.

BIOLOGY: At least partially insectivorous. Builds bubble nest at spawning. Literature on spawning summarized by Breder and Rosen (1966. *Modes of Reproduction in Fishes*) and Goldstein (1971).

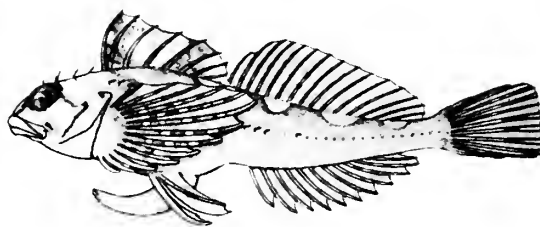
Compilers: D. A. Hensley and W. R. Courtenay, Jr. November 1979.

Clinocottus acuticeps (Gilbert)
Sharpnose sculpin

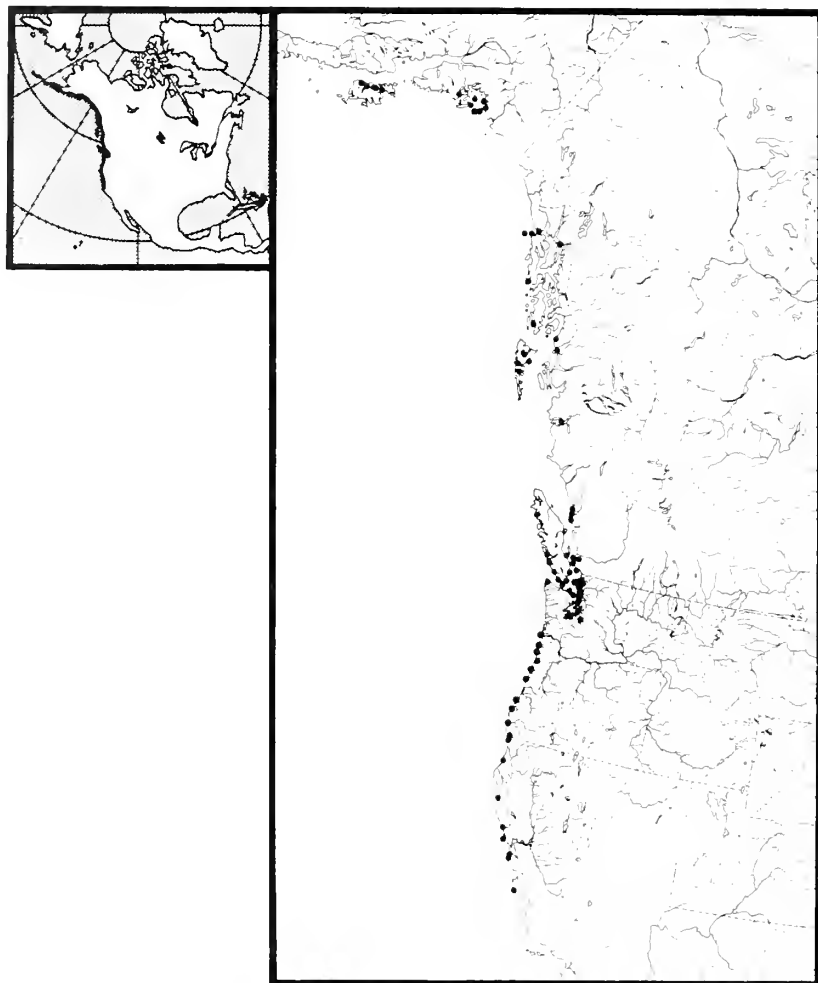
Order Perciformes
Family Cottidae

TYPE LOCALITY: Tidepools at Unalaska, AK (Gilbert 1895. Rept. U.S. Comm. Fish [1893] 19:393-461).

SYSTEMATICS: Bolin (1944. Stanford Ichthyol. Bull. 3:1-135) revised CA members of genus and placed *C. acuticeps* in subgenus *Oxynotus*. Swank (1979. Abstr. 59 Annu. ASIH meetings) reported that five species of *Clinocottus* shared 46% of the enzyme loci and *Clinocottus* about 27% with closely related *Oligocottus maculosus*.



Male (Bolin 1944).



DISTRIBUTION AND HABITAT: From Attu Island, AK in west and Prince William Sound, AK, in north, and possibly Bering Sea (Morrow 1974. *Illustrated Keys to the Freshwater Fishes of Alaska*), south to Big Sur River, Monterey Co., CA. Occurs in shallow water, especially in rocky tidepools. Normally marine, sometimes in brackish water, and rare visitor to fresh water in CA (Moyle 1976. *Inland Fishes of California*) and BC (McAllister 1959. Can. Field-Nat. 73:13-14). Prefers sand, gravel, and rock substrates with mussels (*Mytilus*) and vegetation.

ADULT SIZE: Average 35.3 mm, ranges up to 53.1 mm SL.

BIOLOGY: Male has large intromittent organ. Breeding occurred 4 July in San Juan Islands, WA; eggs were brown, 1 mm in diameter. A female from Wiers Beach contained free eggs on 28 April (Hart 1973. *Pacific Fishes of Canada*).

Compilers: A. Marchand and D. E. McAllister. September 1979.

***Cottus aleuticus* Gilbert**
Coastrange sculpin

Order Perciformes
Family Cottidae

TYPE LOCALITY: Streams of Unalaska, AK (Gilbert 1895. Rept. U. S. Fish Comm. [1893] 19:392-476).

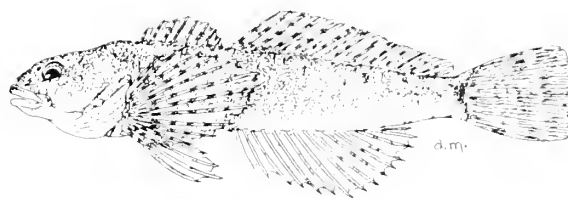
SYSTEMATICS: Originally described as *Uranidea microstoma* from Kodiak Island, AK (Lockington 1881. Proc. U. S. Natl. Mus. [1880] 3:58-59). Gilbert (1895) synonymized *C. microstoma* with his new *C. aleuticus*, and used this name because *C. microstoma* was preoccupied (Robins and Miller 1957. Calif. Fish Game 43:213-33). *Cottus protrusus* considered synonym of *C. aleuticus* (Robins and Miller 1957). McAllister and Lindsey (1961. Natl. Mus. Can. Bull. 172:66-89) and McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*) reported on geographic variation in this species. McAllister and Lindsey (1961) found some evidence for anadromous coastal and freshwater non-coastal populations as in *C. asper*. Larson and Brown (1975. J. Fish. Res. Board Can. 32:21-28) discussed status of a mid-water population in Lake Washington, WA.

DISTRIBUTION AND HABITAT: Pacific slope coastal streams, from San Luis Obispo Co., CA, north to Bristol Bay region of AK and west in Aleutian Island chain to Kiska. Isolated population in Kobuk River (Chukchi Sea drainage) about 805 km north of Bristol Bay population (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Also on Vancouver, Queen Charlotte, and Kodiak islands (McPhail and Lindsey 1970). Typically inhabits riffle areas in lower reaches of medium to large-sized streams where current is moderately rapid to rapid and bottom is gravel or rubble (Bond 1963. Ph.D. diss., Univ. Michigan). Occasionally in estuaries and freshwater lakes. Rather tolerant of brackish waters (Bond 1963).

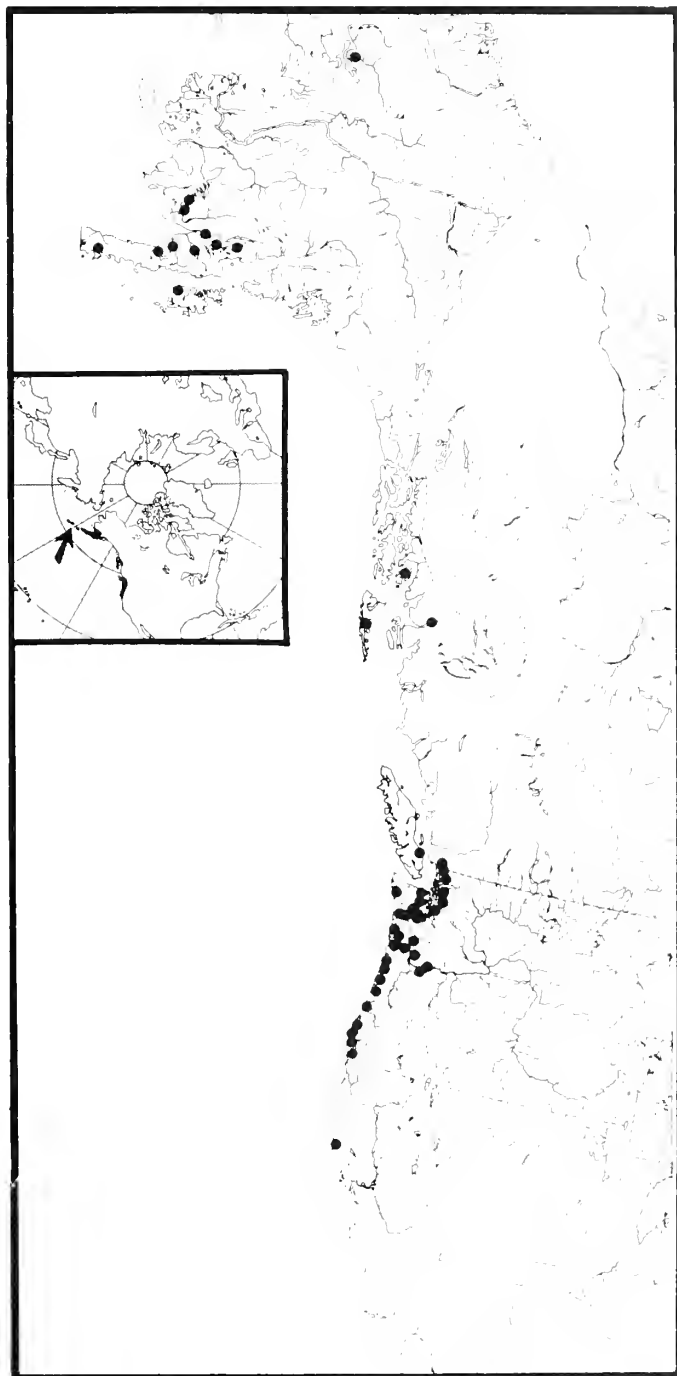
ADULT SIZE: 50-70 mm SL.

BIOLOGY: Biology reviewed by McPhail and Lindsey (1970), Scott and Crossman (1973), and Moyle (1976. *Inland Fishes of California*). Bond (1963) studied ecology in OR, and McLarney (1968. Trans. Am. Fish. Soc. 97:46-48) reported on spawning habits in AK. Biology of lake populations reported by Heard (1965. Trans. Am. Fish. Soc. 94:191-93) and Ikusemiju (1975. J. Fish Biol. 7:235-45). Spawns in spring and mainly eats aquatic insects.

Compiler: R. L. Wallace. August 1978.



CA: Mendocino Co., Navarro River, 75 mm SL (Moyle 1976).



***Cottus asper* Richardson**
Prickly sculpin

Order Perciformes
Family Cottidae

TYPE LOCALITY: Columbia River, probably near Ft. Vancouver, Washington Territory (Richardson 1836. *Fauna Boreali-Americana*).

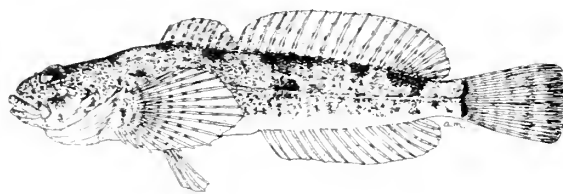
SYSTEMATICS: Early nomenclature confusing. Krejsa (1967. *Pac. Sci.* 21:241-51) reviewed nomenclatural history and synonymy. Robins and Miller (1957. *Calif. Fish Game* 43:213-33) and McPhail and Lindsey (1970. *Freshwater Fishes of Northwestern Canada and Alaska*) also reviewed nomenclature. Two forms, a sparsely prickled coastal form and heavily prickled inland form, have been recognized and may be genetically distinct (Bond 1963. Ph.D. diss., Univ. Michigan; McAllister and Lindsey 1961. *Natl. Mus. Can. Bull.* 172: 66-89; Krejsa 1965. Ph.D. diss., Univ. British Columbia; 1967. *Pac. Sci.* 21:414-22). Placed in *C. asper* species group (Bailey and Bond 1963. *Occas. Pap. Mus. Zool. Univ. Mich.* 634:1-27).

DISTRIBUTION AND HABITAT: Pacific coastal streams and lakes from Ventura River, CA, to Seward, AK. Farther inland than *C. aleuticus*, but has crossed Continental Divide only in Peace River, BC (McPhail and Lindsey 1970). Present on Queen Charlotte and Vancouver islands. Typically inhabits pools and waters of slight current and is often on bottom of fine materials, predominantly sand. Also in tidewater areas and has high tolerance for brackish water (Bond 1963).

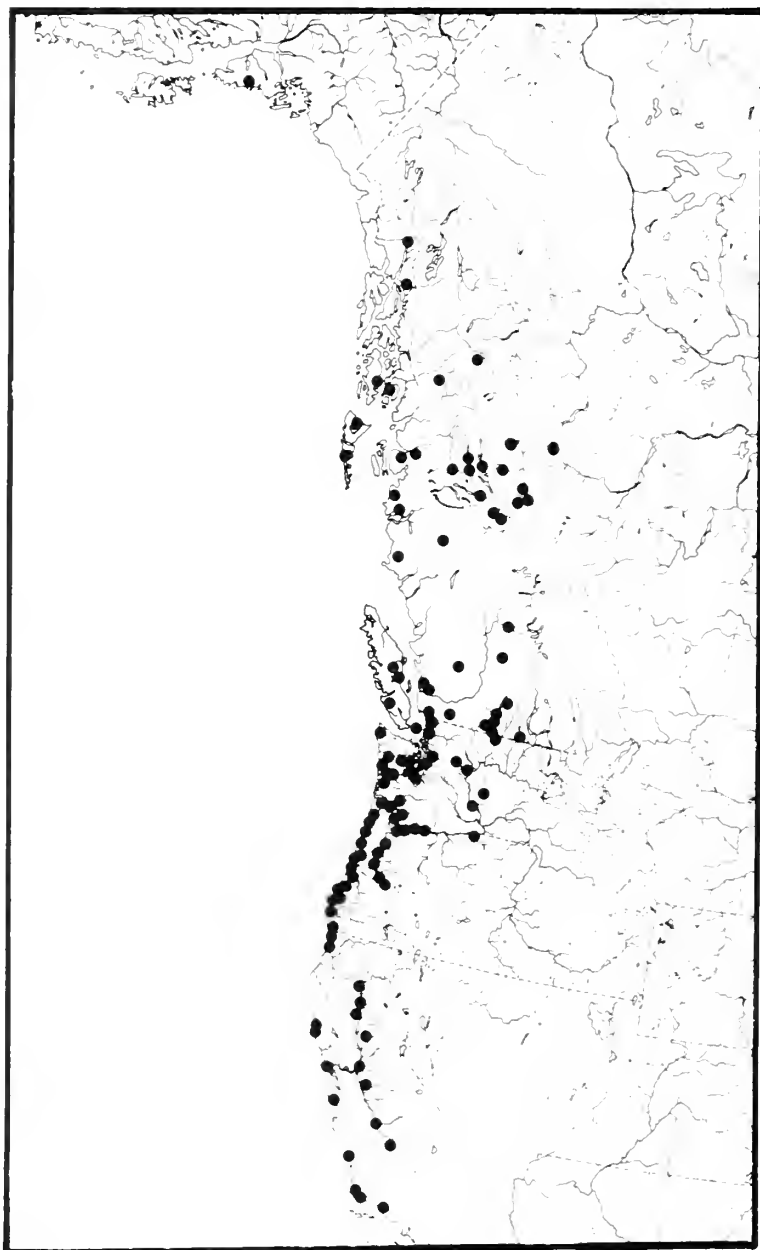
ADULT SIZE: 50-90 mm SL.

BIOLOGY: Krejsa (1967) studied spawning, migration, and distribution in a coastal stream of BC, and Bond (1963) studied ecology in OR. Spawning and fecundity in WA reported by Patten (1971. *Am. Midl. Nat.* 85:493-506). After hatching larvae become planktonic for 30-35 days before settling to bottom (Northcote and Hartman 1959. *Copeia*:156-58). Food consists largely of aquatic insect larvae, but fish become increasingly important in larger individuals (70 mm SL). Larger and longer-lived than other western members of genus.

Compiler: R. L. Wallace. August 1978.



CA: Solano Co., Suisun Creek,
88 mm SL (Moyle 1976).



***Cottus asperimus* Rutter**
Rough sculpin

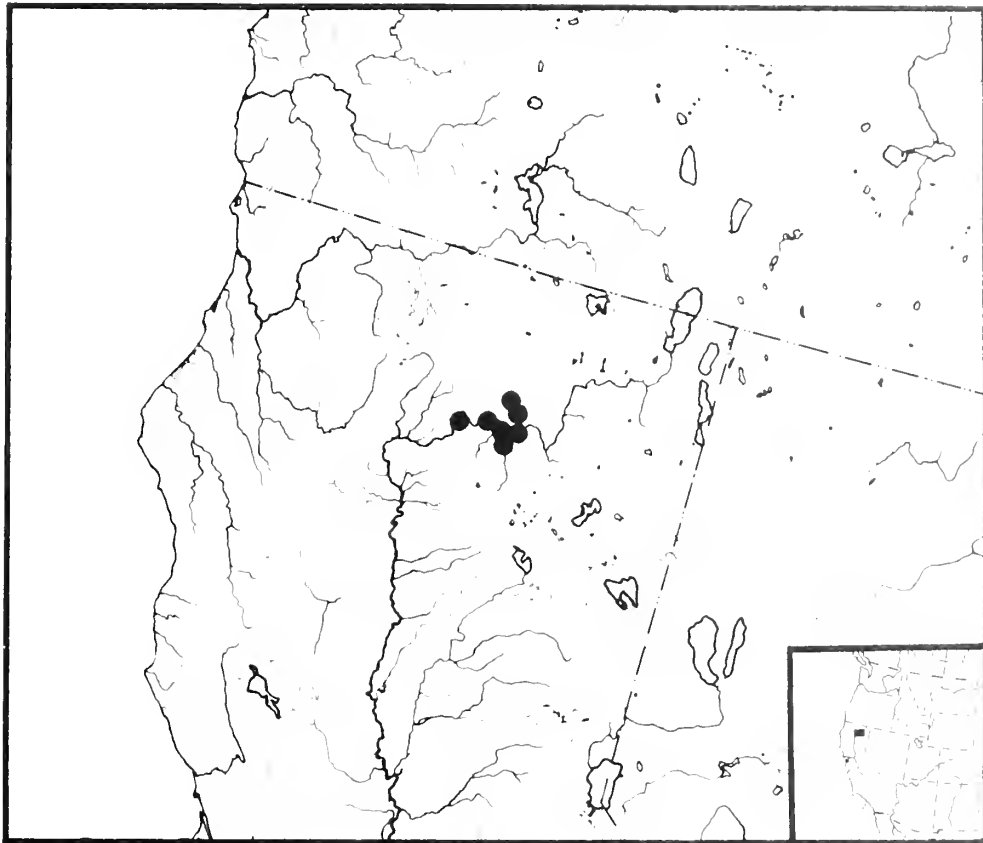
Order Perciformes
Family Cottidae

TYPE LOCALITY: Fall River at Dana, CA
(Rutter 1908. Bull. U.S. Bur. Fish 27:103-52).

SYSTEMATICS: Closely related to *C. tenuis*
(Robins and Miller 1957. Calif. Fish Game
43:213-33).



CA : Shasta Co., Hat Creek, 72
mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Abundant
in soft-bottomed runs and riffles in Fall
River and tributaries, lower Hat Creek, and
some sections of Pit River, Shasta and Las-
sen cos., CA. Found in cool, clear water, usu-
ally 1-2 m deep, that supports beds of aquatic
plants.

ADULT SIZE: 30-80 mm SL.

BIOLOGY: Predator on small invertebrates,
especially larvae of Chironomidae and Baeti-
dae. Most aspects of life history similar to
other Pacific coast *Cottus* (Daniels and
Moyle 1978. Copeia:633-79).

Compiler: P. B. Moyle. January 1979.

***Cottus baileyi* Robins**
Black sculpin

Order Perciformes
Family Cottidae

TYPE LOCALITY: Middle Fork Holston River, 9.7 km ene of Marion, Smyth Co., VA (Robins 1961. Copeia:305-15).

SYSTEMATICS: Robins (1961) indicated it as member of *C. bairdi* species group, but relationships within this group unclear.



TN: Johnson Co., Holston River system, 45 mm SL (J. L. Harris).



DISTRIBUTION AND HABITAT: Endemic to montane portions of upper Tennessee drainage. In four main branches of upper Holston system (North, Middle, and South forks and Watauga River), VA and TN. Localized in extreme headwaters of upper Clinch system, Tazewell Co., VA (Masnik 1974. Ph.D. diss., Virginia Polytech. Inst. State Univ.). Typically occupies riffles of cool, small, rocky streams and springs. Often common.

ADULT SIZE: 50-70 mm SL.

BIOLOGY: Feeds almost exclusively on immature aquatic insects during summer (Novak and Estes 1974. Trans. Am. Fish. Soc. 103:270-76). Robins (1961) reported breeding individuals during April and three-tiered egg masses in riffles of Middle Fork, Holston River.

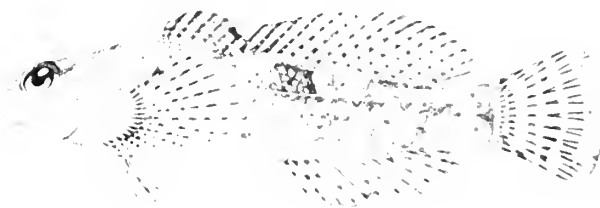
Compiler: S. P. Platania, June 1978.

Cottus bairdi Girard
Mottled sculpin

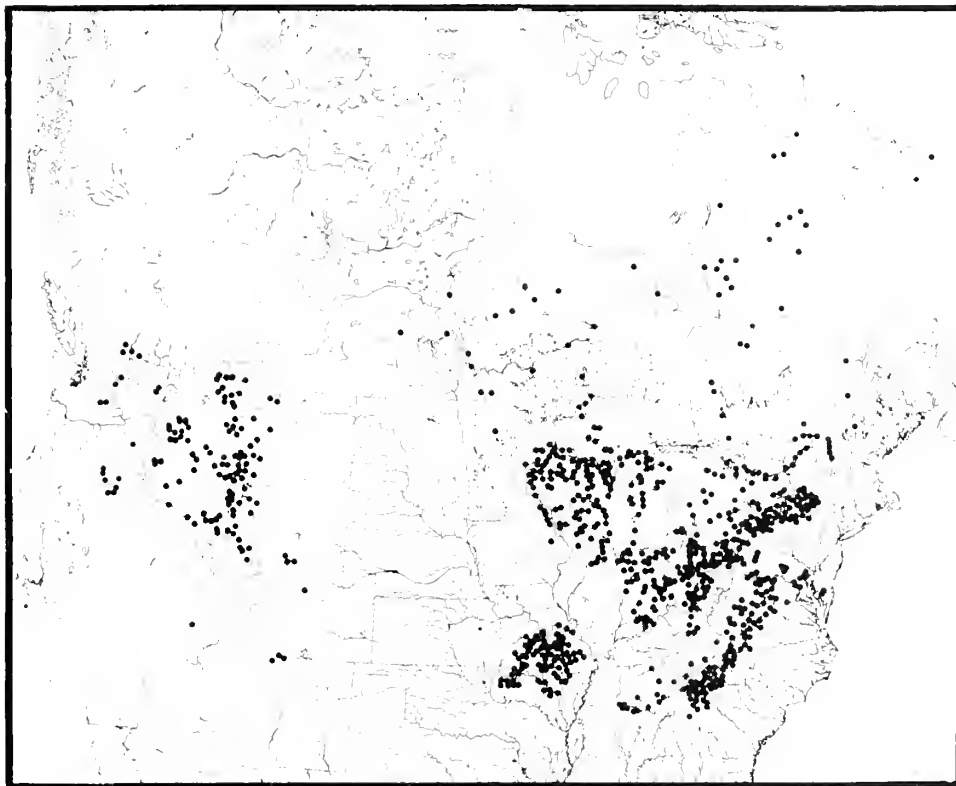
Order Perciformes
Family Cottidae

TYPE LOCALITY: Mahoning River, OH (Girard 1850. Proc. Am. Assoc. Adv. Sci. [1849]:409-11).

SYSTEMATICS: Bailey and Bond (1963. Occas. Pap. Mus. Zool. 634:1-27) presented summary of species included in *C. bairdi* group. Considerable geographic variation throughout wide range of species, and overall systematic picture unresolved. Some populations classified as *C. bairdi* may be distinct species. Scott and Crossman (1973. *Freshwater Fishes of Canada*) noted that Canadian populations have received insufficient attention for subspecific recognition. Robins (1954. Ph.D. diss., Cornell Univ.) studied systematics in eastern United States. McAllister (1964. J. Fish. Res. Board Can. 21:1339-42) discussed separation of *C. bairdi* from *C. cognatus*.



(NCSM)



DISTRIBUTION AND HABITAT: Discontinuous throughout much of North America, from Savannah, Mobile, and Tennessee river drainages in GA and AL, north to Canada. Disjunct populations in MO, AR, UT, and NM. In clear, cold to warm (typically cool) streams and lakes with sand and gravel substrates. Considerable variation in habitat preference throughout wide range. Often very common.

ADULT SIZE: 43-125 mm SL.

BIOLOGY: Bailey (1952. Copeia: 243-55) and Zarbock (1952. Trans. Am. Fish. Soc. [1951] 81:249-59) studied life history and ecology in southwestern MT and northern UT, respectively. Ludwig and Norden (1969. Milw. Public Mus. Occas. Pap. Nat. Hist. 2:1-67) investigated age, growth, and reproduction in a WI population. Food habits discussed by Ricker (1934. Univ. Toronto Stud. Biol. [Ser. 37] Publ. Ont. Fish. Res. Lab. 49:1-114), Daiber (1956. Copeia:141-51), and others. Hallam (1959. J. Fish. Res. Board Can. 16:147-73) studied habitat.

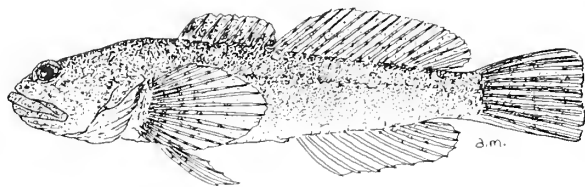
Compiler: D. S. Lee, February 1978.

Cottus beldingi Eigenmann and
Eigenmann
Piute sculpin

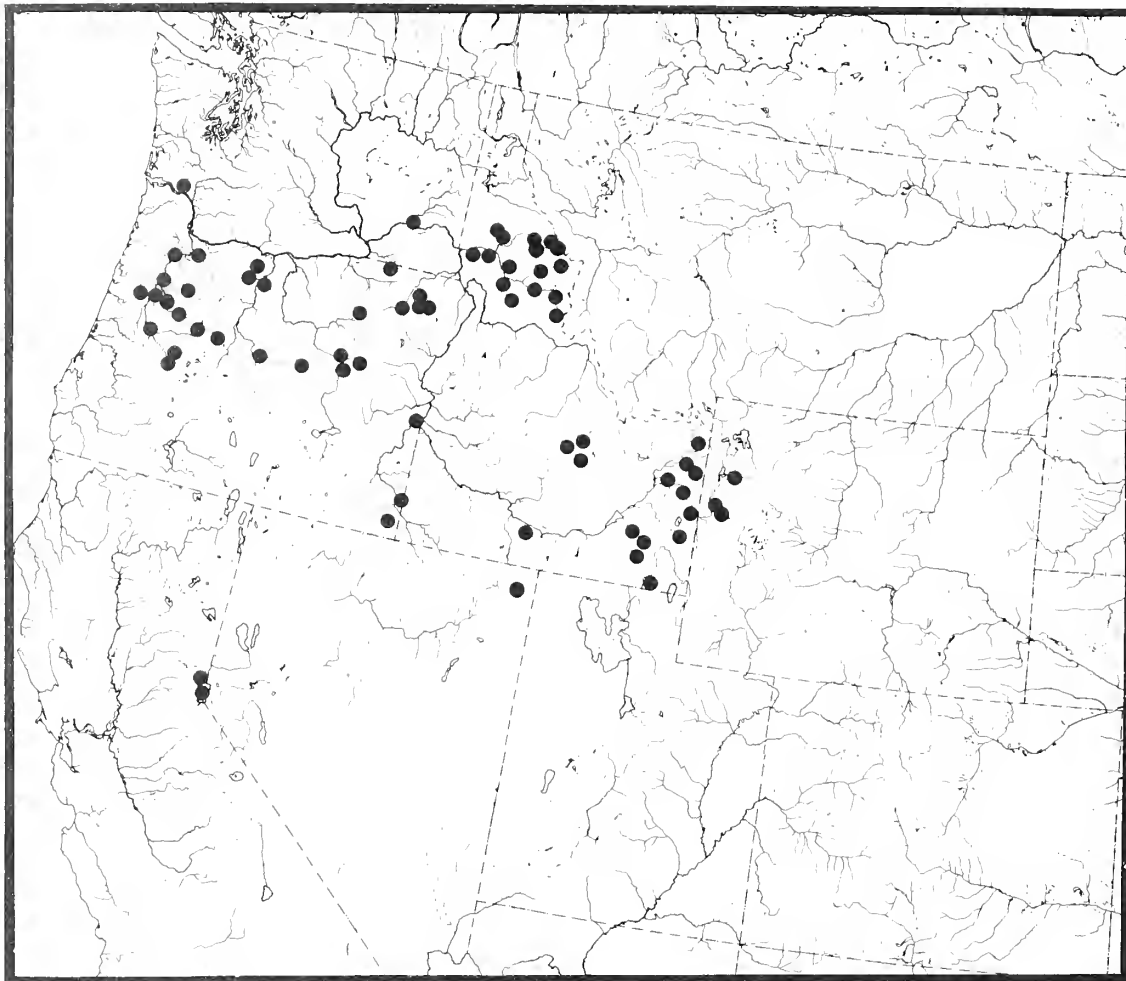
Order Perciformes
Family Cottidae

TYPE LOCALITY: Lake Tahoe, CA (Eigenmann and Eigenmann 1891. Am. Nat. 25: 1132).

SYSTEMATICS: Occasionally considered subspecies of *C. bairdi* in the past (LaRivers 1962. *Fishes and Fisheries of Nevada*). Bailey and Bond (1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27) synonymized *C. annae* and *C. tubulatus* with *C. beldingi* and placed it in the *C. bairdi* species group.



CA: Placer Co., Sagehen
Creek, 75 mm SL (Moyle
1976).



DISTRIBUTION AND HABITAT: Portions of Lahontan and Bonneville basins of CA, NV, UT, and ID and Columbia River drainage of OR, WA, ID, and WY (including upper Snake in ID and WY). Also in upper Colorado River drainage, CO. Prefers swift riffles with rubble or large-gravel substrate (Bond 1963. Ph.D. diss., Univ. Michigan), but also in lakes. In Lake Tahoe has been collected as deep as 210 m, but most abundant in waters less than 60 m deep (Baker and Cordone 1969. Calif. Fish Game 55:285-97).

ADULT SIZE: 40-55 mm SL.

BIOLOGY: Biology of this species in Lake Tahoe and Sagehen Creek, CA, summarized by Moyle (1976. *Inland Fishes of California*). Spawns in May and June. Eggs laid in clusters on undersides of rocks and guarded by male. Feeds on aquatic insects and miscellaneous bottom organisms in Sagehen Creek (Moyle 1976). In Lake Tahoe, bottom organisms, planktonic crustacea and detritus, and filamentous algae form bulk of diet (Ebert and Summerfelt 1969. Calif. Fish Game 55:100-20). Preyed upon by brook, lake, brown, and rainbow trout in CA.

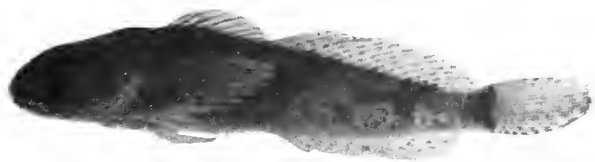
Compiler: R. L. Wallace. August 1978.

Cottus caroliniae (Gill)
Banded sculpin

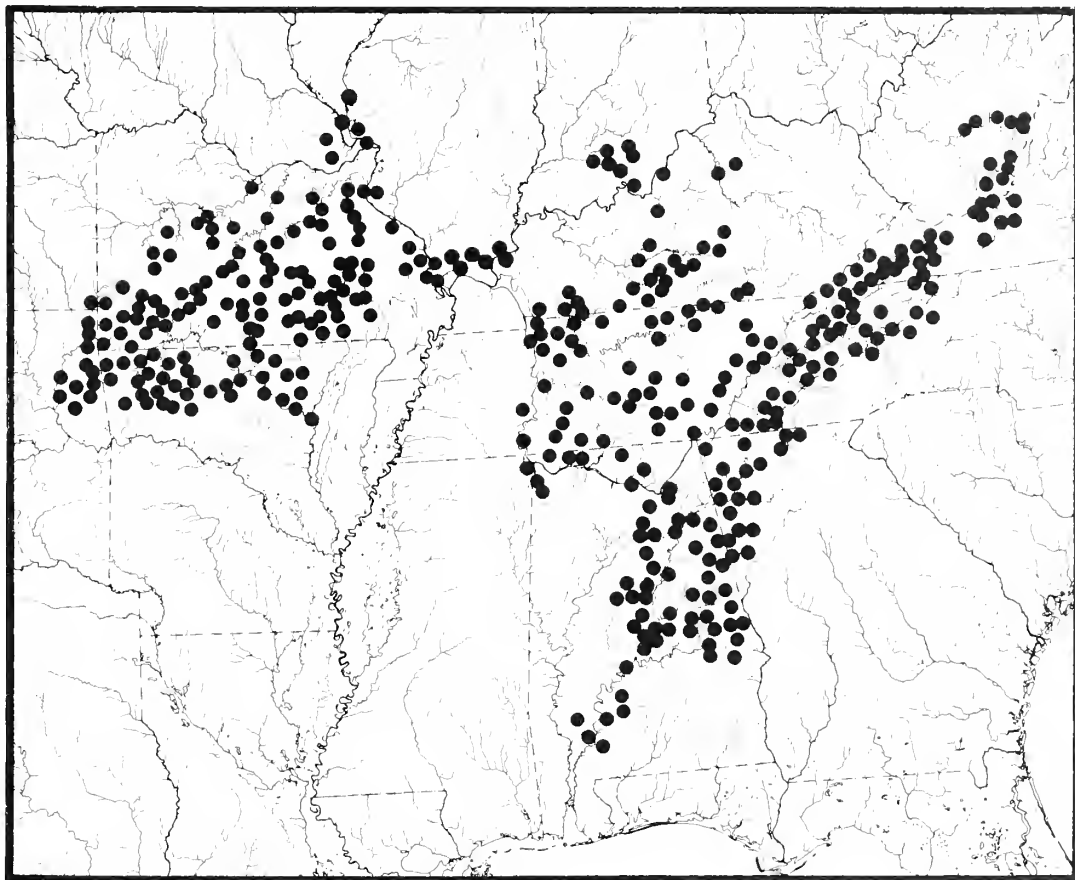
Order Perciformes
Family Cottidae

TYPE LOCALITY: Near Maysville, KY (Gill 1861. Proc. Bost. Soc. Nat. Hist. [1862] 8:40-42).

SYSTEMATICS: Robins (1954. Ph.D. diss., Cornell Univ.) reviewed systematics and recognized four subspecies including *C. c. caroliniae* and *C. c. zopherus*; third described as *C. c. infernatus* (Williams and Robins 1970. Am. Midl. Nat. 83:368-81); fourth undescribed, found mainly in New (upper Kanawha) drainage, VA and WV. Closest relative apparently *C. girardi* of Potomac River drainage.



AL: Etowah-St. Clair Co., Coosa River system, 63 mm SL (Smith-Vaniz 1968).



DISTRIBUTION AND HABITAT: Generally confined to uplands and mountains of Mississippi drainage from NC west to OK, and AL north to southern IL (Tennessee, Cumberland, eastern Mobile Bay, Green and Kentucky river drainages), and throughout Ozark uplands. Inhabits cool, clear streams but seems more tolerant of higher temperatures and more downstream situations than *C. bairdi*. Often common in small and moderate-sized cool and warm streams. *Cottus c. infernatus* extends notably far into the Gulf coastal plain; *C. c. zopherus* inhabits Coosa River system.

ADULT SIZE: ca. 70-120 mm SL.

BIOLOGY: A thorough study of life history and ecology needed. Williams and Robins (1970) reported *C. c. infernatus* spawns in January and February at 9-13°C. Indirect evidence suggests species lays eggs singly or broadcasts them indiscriminantly; no nests have been found. Eggs smaller and more numerous than those of *C. bairdi* complex.

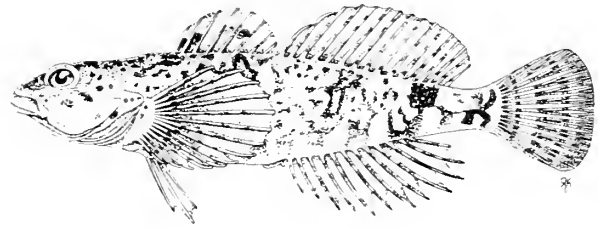
Compiler: D. S. Lee. February 1978.

Cottus cognatus Richardson
Slimy sculpin

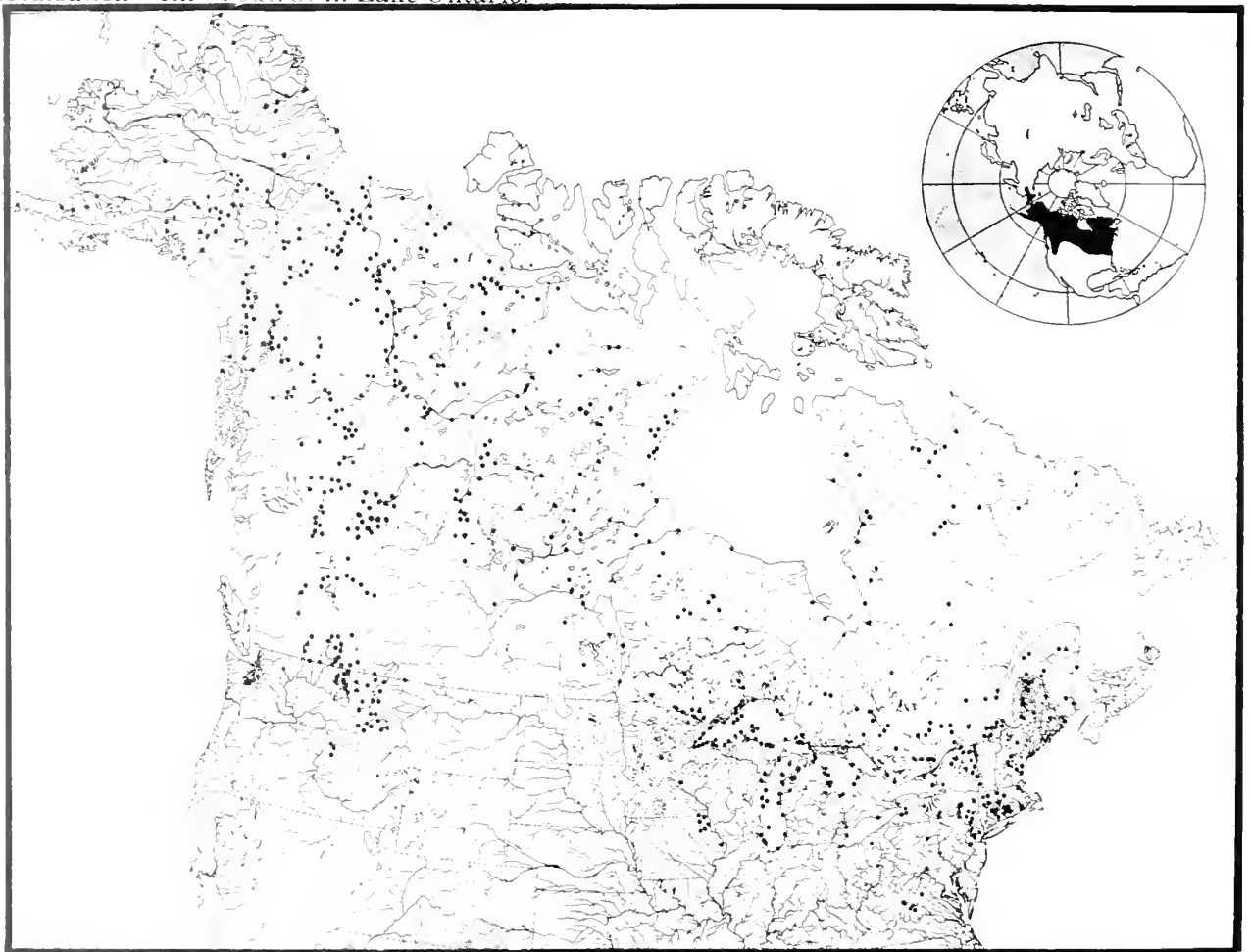
Order Perciformes
Family Cottidae

TYPE LOCALITY: Clear waters of Great Bear Lake, Lat. 64 1/2° N, NT (Richardson 1836, *Fauna Boreali-Americana*).

SYSTEMATICS: McAllister and Lindsey (1961, Bull. Natl. Mus. Can. Contrib. Zool. [1959] 172:66-89) synonymized *C. philonips*, *C. kaganowskii*, and *C. chamberlaini* with *C. cognatus*, and described three forms within its range: one in AK and northwestern Canada with four pelvic rays and two rays on last anal basal; one to southeast of first with three pelvic rays and single ray on last anal basal; and one in southern BC with intermediate characters. Some evidence exists for hybridization with *C. bairdi* in Lake Ontario.



PA: Clinton Co., Fishing Creek, 64 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Eastern Siberia in Anadyr River and Chukotsk Peninsula, St. Lawrence Island in Bering Sea and AK southwest of Rockies to WA, east of Rockies in Arctic and Hudson Bay drainages to QU and Labrador, Great Lakes and NB, and south to VA on Atlantic slope. Prefers cool, clear or muddy waters of lakes and rivers, sometimes in brackish water, and springfed streams in the south. In NT occurs in lakes less than 10 m, whereas in Great Lakes is commonest at over 30 m depth.

ADULT SIZE: 50-80 mm TL.

BIOLOGY: Spawns about May under or amongst rocks. Eggs and young guarded by male. Food consists of aquatic insects, small crustaceans, fish, and some vegetation. Preyed on by lake and brook trout, northern pike, and burbot.

Compilers: R.L. Wallace, D.E. McAllister, and M. Rankin. May 1978.

***Cottus confusus* Bailey and Bond**
Shorthead sculpin

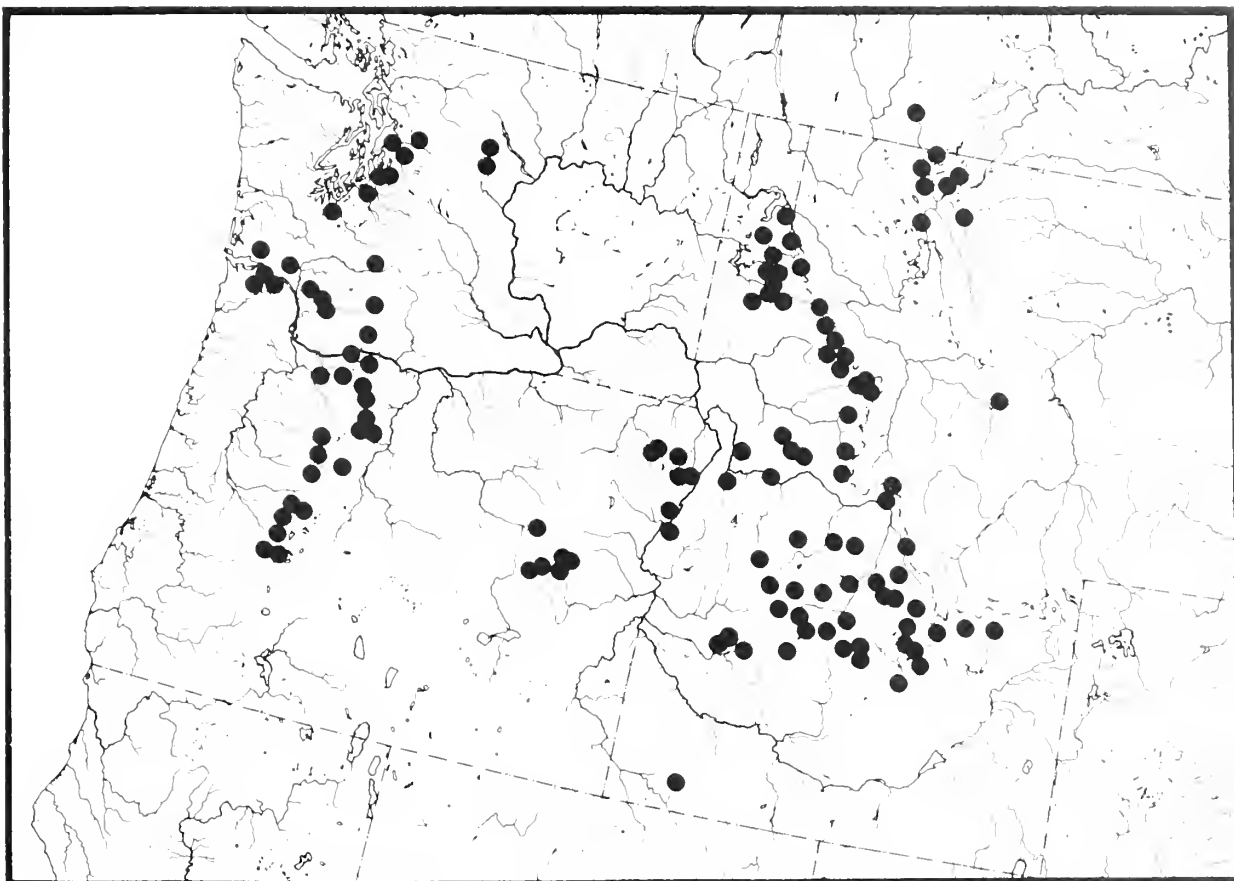
Order Perciformes
Family Cottidae

TYPE LOCALITY: Salmon River, tributary of Snake River, 40 km nw of Ketchum, Blaine Co., ID (T7N, R14E, Sec. 36) (Bailey and Bond 1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27).

SYSTEMATICS: Recognized as a distinct species in 1963; previously misidentified on separate occasions as *C. beldingi*, *C. bairdi punctulatus*, and *C. bairdi* ssp. Bears close similarity to *C. bairdi* with which it is often sympatric.



ID: Butte Co., Big Lost River,
58 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Unique intermittent occurrence of *C. confusus* throughout Puget Sound and Columbia River drainages is explained in part by its preference for riffle areas of streams with cool summer temperatures. Also found in medium and large waters, including the Columbia River. Recently reported from a headwater tributary of the Deschutes River (Bisson 1977. Northwest Sci. 51:43-45). Common in many streams of lower Columbia and Snake river systems in OR and ID. Present in Boise, Salmon, and Clearwater systems of southeast ID. In a few tributaries of the Flathead and Little Blackfoot Rivers in MT, and just into BC in the Flathead. Sympatric with other species of *Cottus* (*bairdi*, *cognatus*, *beldingi*, *rhotheus*, and *asper*).

ADULT SIZE: 71-101 mm SL.

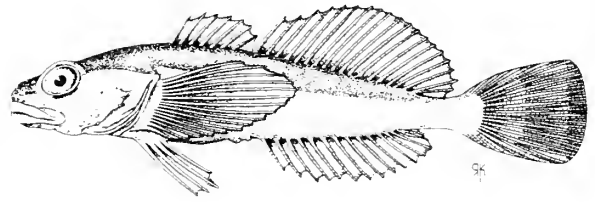
BIOLOGY: Spawns in early spring (mid-April in Big Lost River, ID) as do most cottids, laying eggs on undersurface of rocks in rubble-boulder areas. Mature at age two-three depending on location. Mean fecundity 326 eggs female. Growth: 10-12 mm year after first year. Maximum life span six years. Food habits as in most cottids; relies chiefly on benthic aquatic insect larvae, occasionally taking other sculpins and or sculpin eggs. Shows seasonal variation in diet and feeding intensity.

Compilers: D. A. Cannamela and K. W. Gasser. June 1978.

***Cottus echinatus* Bailey and Bond**
Utah Lake sculpin

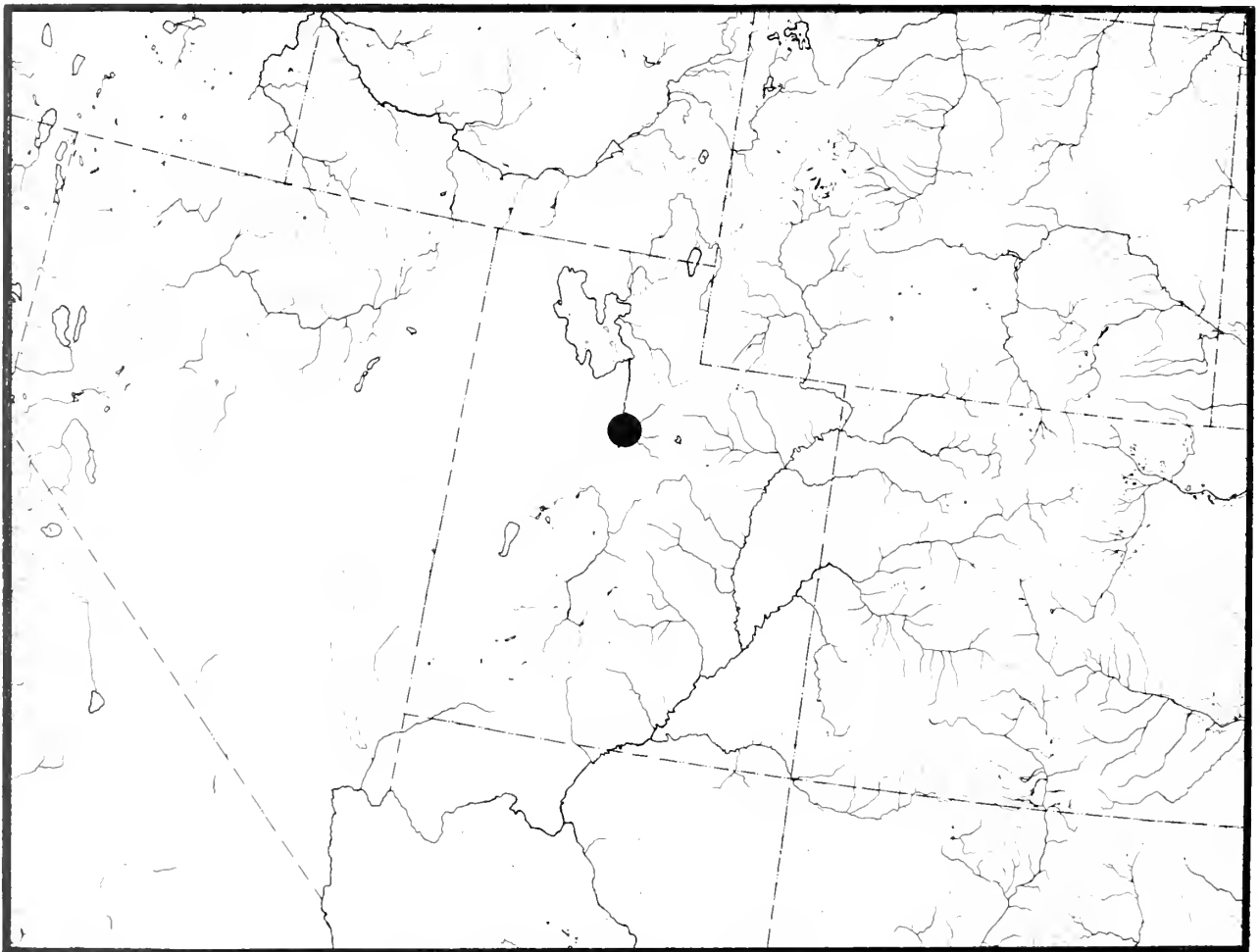
Order Perciformes
Family Cottidae

TYPE LOCALITY: Utah Lake at mouth of Provo River, Utah Co., UT (Bailey and Bond 1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27).



(NCSM)

SYSTEMATICS: First recognized as distinct species by Jordan and Gilbert (1881. Proc. U. S. Natl. Mus. [1880] 3:459-65), but they used *C. semiscaber* as species name, which properly is synonym of *C. bairdi* (Bailey and Bond 1963). In *C. bairdi* species group; considered most closely related to *C. extensus* (Bailey and Bond 1963).



DISTRIBUTION AND HABITAT: Formerly restricted to Utah Lake, UT, but probably now extinct. May not have survived low lake levels of 1930's (Tanner 1936. Utah Acad. Sci. Arts Lett. 13:155-84).

BIOLOGY: No known published accounts.

ADULT SIZE: 50-70 mm SL, 92 mm SL maximum.

Compiler: R. L. Wallace. August 1978.

***Cottus extensus* Bailey and Bond**
Bear Lake sculpin

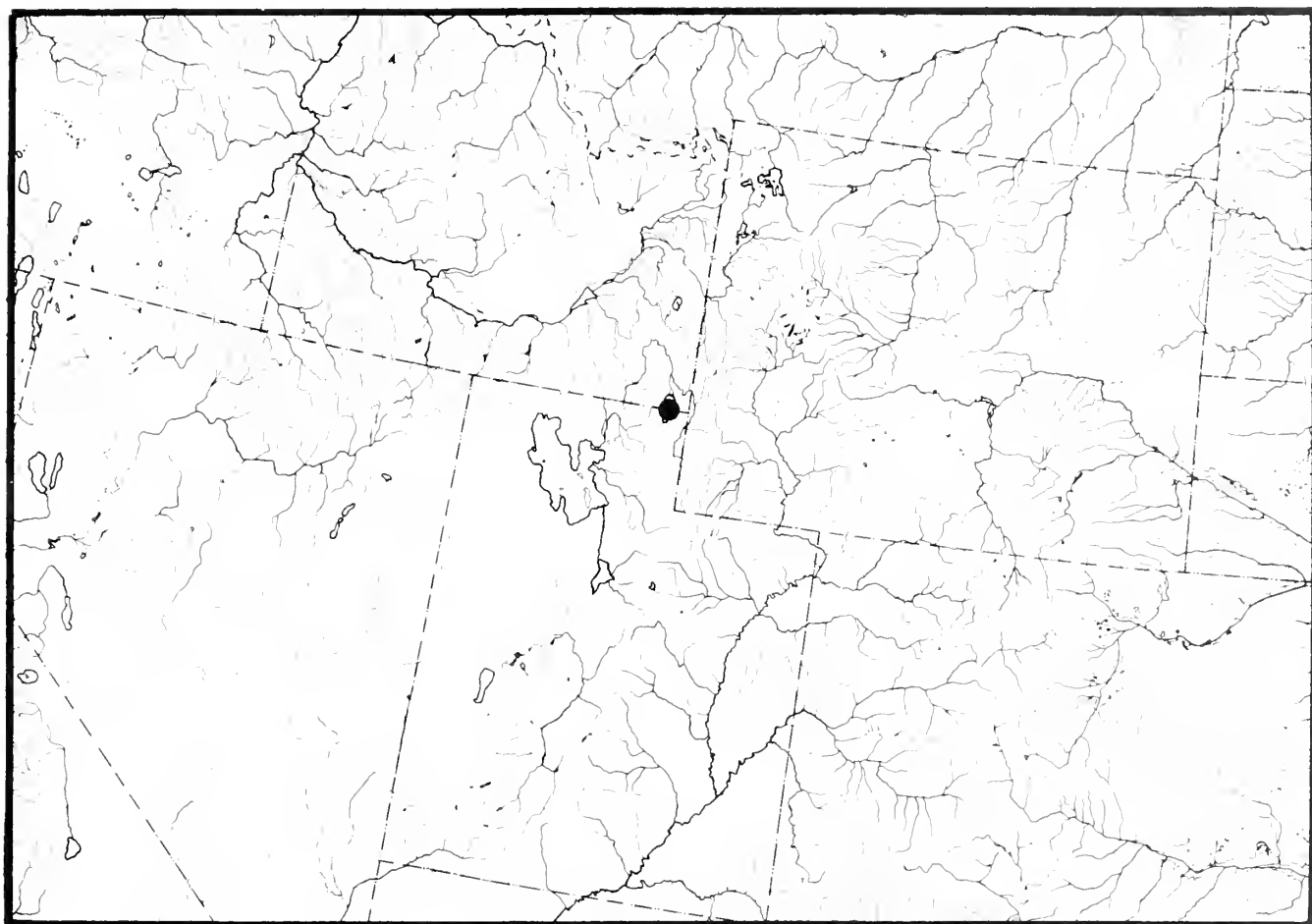
Order Perciformes
Family Cottidae

TYPE LOCALITY: Bear Lake, south of the South Eden Delta, Rich Co., UT (Bailey and Bond 1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27).

SYSTEMATICS: Nomenclature reviewed by Bailey and Bond (1963). First recognized as an undescribed species by C. L. Hubbs and L. E. Perry in the early 1940's. Placed in *C. bairdi* species group and considered most closely related to *C. echinatus* (Bailey and Bond 1963).



ID: Lake Co., South Bear
Lake, 76 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Only in Bear Lake, UT-ID. An abundant benthic species from shoreline to depths of at least 53 m (McConnell et al. 1957. *Bear Lake Its Fish and Fishing*).

BIOLOGY: Little known. Apparently spawns near shore around rocks in April (McConnell et al. 1957). Fed upon by lake cutthroat, and rainbow trout, and Bonneville whitefish.

ADULT SIZE: 50-90 mm SL, 109 mm SL maximum.

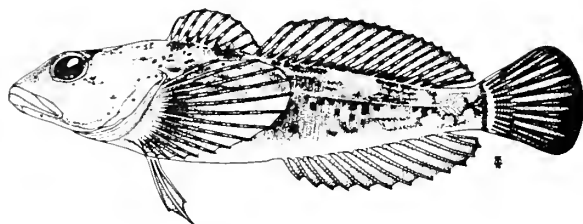
Compiler: R. L. Wallace. August 1978.

Cottus girardi Robins
Potomac sculpin

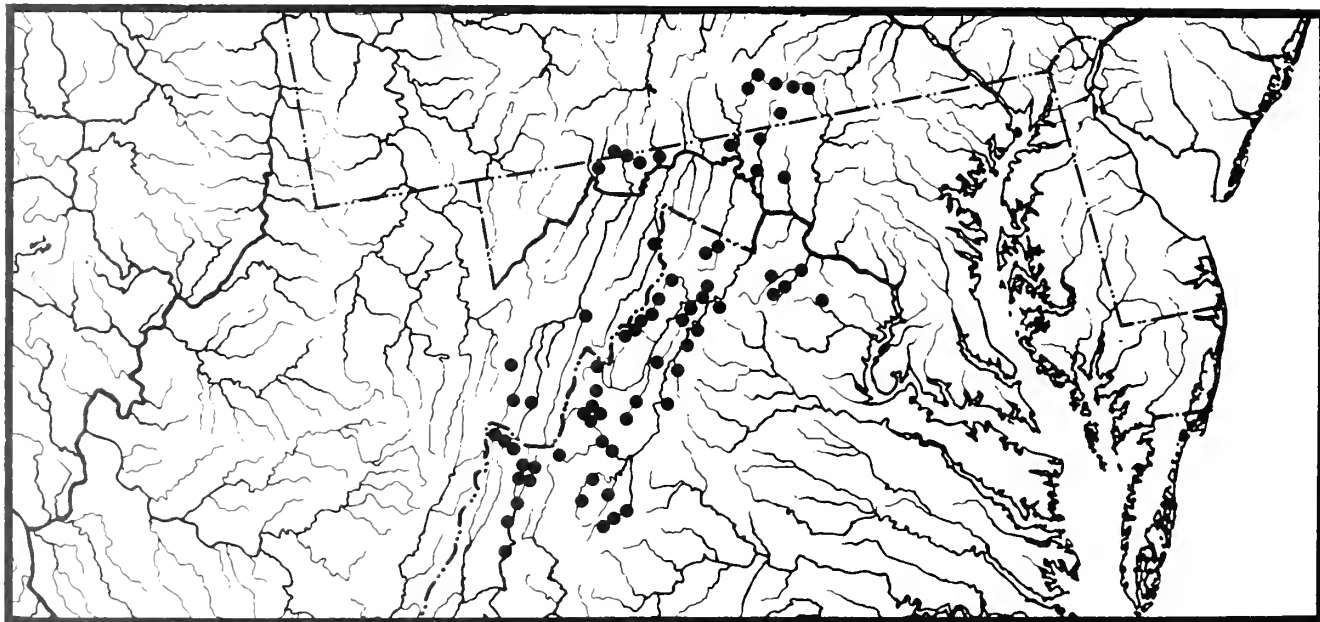
Order Perciformes
Family Cottidae

TYPE LOCALITY: (East Branch) Conococheague Creek, "9.6" miles (actually 0.6 miles [1.0 km] *fide* Savage 1962. Copeia: 848-50) ne of Chambersburg on route 11, Franklin Co., PA (Robins 1961. Copeia: 305-15).

SYSTEMATICS: Synonymized with *C. bairdi* by Savage (1962). Nearly completely sympatric over range of *C. girardi*, commonly syntopic, and separable indicating they are not conspecific. Distinction from *C. bairdi* confirmed by restudy of coloration and morphology and by biochemical analysis (Matthews in press. Copeia; Strauss 1977. M.S. thesis, Pennsylvania State Univ.), and by comparative biological studies (Matheson 1979. M.A. thesis, William and Mary College). Reassigned to *C. carolinae* species group. Close relative of *C. c. carolinae* and particularly close to undescribed form in New (upper Kanawha) drainage, VA and WV (Robins 1961). Exact status in group remains unclear.



(NCSM)



DISTRIBUTION AND HABITAT: Widespread in Ridge and Valley, Blue Ridge, and upper Piedmont of Potomac drainage, VA, WV, MD, and PA. Known in James drainage, VA, only from Cowpasture River system since 1958. Occupies cold to warm, usually clear, small to medium-sized streams with varied stony substrate generally lacking heavy siltation. Often common. Juveniles most common in areas of little or no current with silty overlay; females may move into stronger current with maturity but males do not. Common in beds of aquatic vascular plants, mostly *Elodea*. Tends to occupy more downstream, warmer and slower areas than *C. bairdi*, but commonly found

together and occasionally both with *C. cognatus*.

ADULT SIZE: 45-113 mm SL.

BIOLOGY: Major food items are immature ephemeroptera, trichoptera, and chironomids; copepods and nymphs of other mayflies seasonally important; ca. 1% fishes. Young first found in May; nest unknown. Time of appearance of young and ovary maturation suggest late winter or early spring spawning. Data from Naked Creek, Shenandoah system, VA (Matheson 1979).

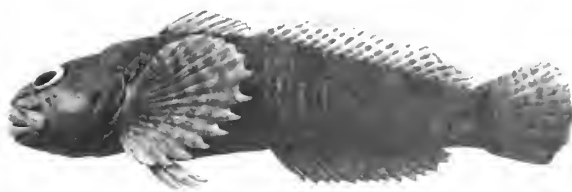
Compilers: R. E. Jenkins, R. E. Matheson, and R. E. Strauss. July 1979.

***Cottus greenei* (Gilbert and Culver)**
Shoshone sculpin

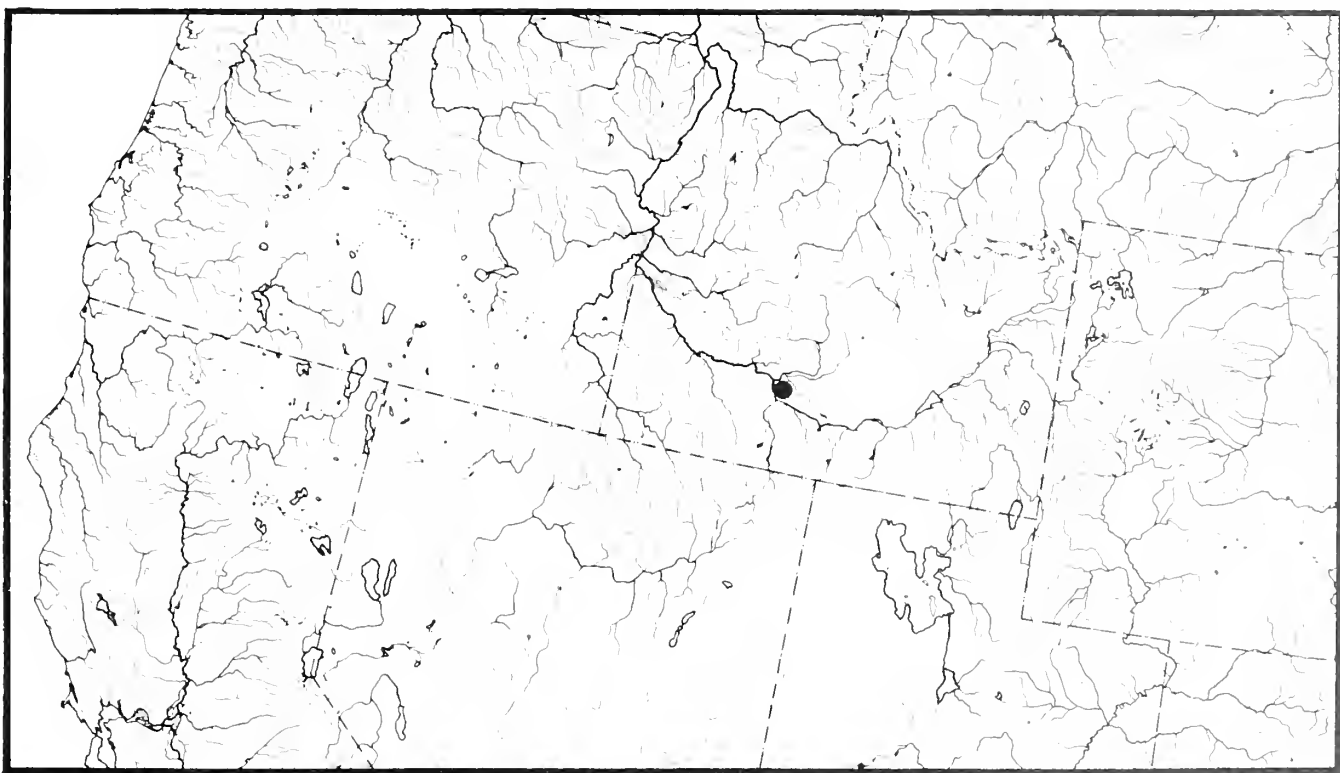
Order Perciformes
Family Cottidae

TYPE LOCALITY: Thousand Springs, Snake River, Gooding Co., ID, near mouth of Salmon Fall River (Gilbert and Culver *in* Jordan and Evermann 1898. U.S. Natl. Mus. Bull. 47: 1241-2183).

SYSTEMATICS: Considered a member of *C. asper* species group (Bailey and Bond 1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27).



ID: Gooding Co., Riley Creek (Hagerman Hatchery Raceway), Thousand Springs, 69 mm SL (R. L. Wallace).



DISTRIBUTION AND HABITAT: Only in small, clear, spring-fed streams in Hagerman Valley, ID. Collected from four streams in the area and possibly occurs in main Snake River in Thousand Springs area. Considered a rare species (Miller 1972. Trans. Am. Fish. Soc. 101:239-52).

BIOLOGY: No published accounts known.

ADULT SIZE: 50-75 mm SL.

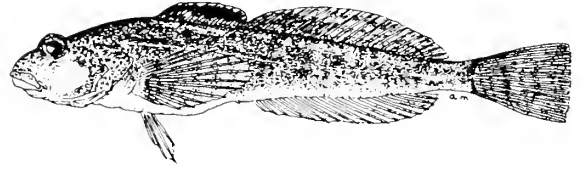
Compiler: R. L. Wallace. April 1978.

***Cottus gulosus* (Girard)**
Riffle sculpin

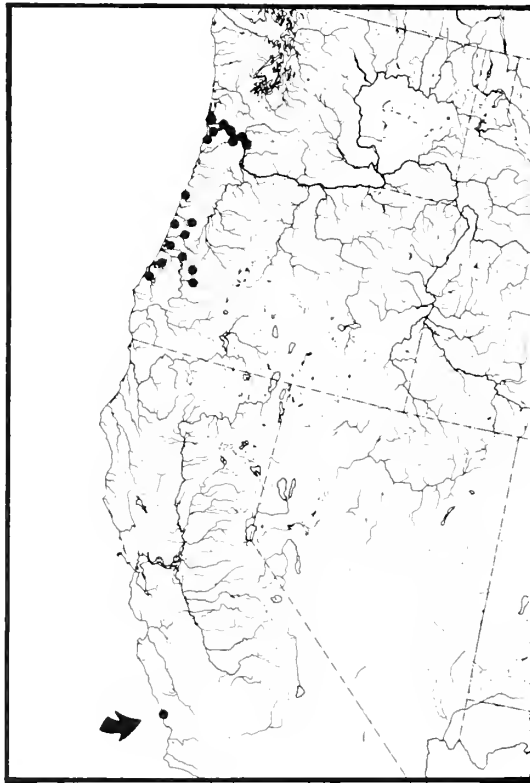
Order Perciformes
Family Cottidae

TYPE LOCALITY: San Mateo Creek and San Joaquin River, CA (Girard 1854. Proc. Acad. Nat. Sci. Phila. [1854-55] 7:142-56).

SYSTEMATICS: Considerable confusion exists in early literature. Often included in *C. bairdi* complex (Robins and Miller 1957. Calif. Fish Game 43:213-33). Many early records may in fact be *C. asper*, *C. klamathensis*, *C. pitensis*, or *C. perplexus* (Moyle 1976. *Inland Fishes of California*). Synonymized with *C. perplexus* by Schultz (1930. Copeia:14-15), but removed by Robins and Miller (1957). *Cottus shasta* considered synonym of *C. gulosus* (Robins and Miller 1957). Placed in *C. asper* species group (Bailey and Bond 1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27).



CA: Santa Clara Co., Bodfish Creek, 53 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Disjunct distribution. In coastal streams from Morro Bay, CA, north to Noyo River, CA, and from Coquille River, OR, north to Puget Sound, WA. Throughout most of Sacramento-San Joaquin River drainage, but absent from Trinity, Klamath, and Rogue rivers (Bond 1963. Ph.D. diss., Univ. Michigan; Moyle 1976). Prefers cool waters and gravel substrate in upstream sections of small creeks, but tends to avoid swifter riffles (Bond 1963). Inhabits wider variety of habitats when not found with other sculpins, including quiet water with sand substrate. Can withstand brackish water (Bond 1963).

ADULT SIZE: 50-70 mm SL.

BIOLOGY: Millikan (1968. M.S. thesis, Univ. Washington) and Bond (1963) studied life history and ecology. Spawns during spring in riffle areas. Eggs deposited in clusters under rocks and guarded by male. Feeds mainly on aquatic insects, as well as isopods, amphipods, and small snails (Millikan 1968).

Compiler: R. L. Wallace. August 1978.

Cottus klamathensis Gilbert
Marbled sculpin

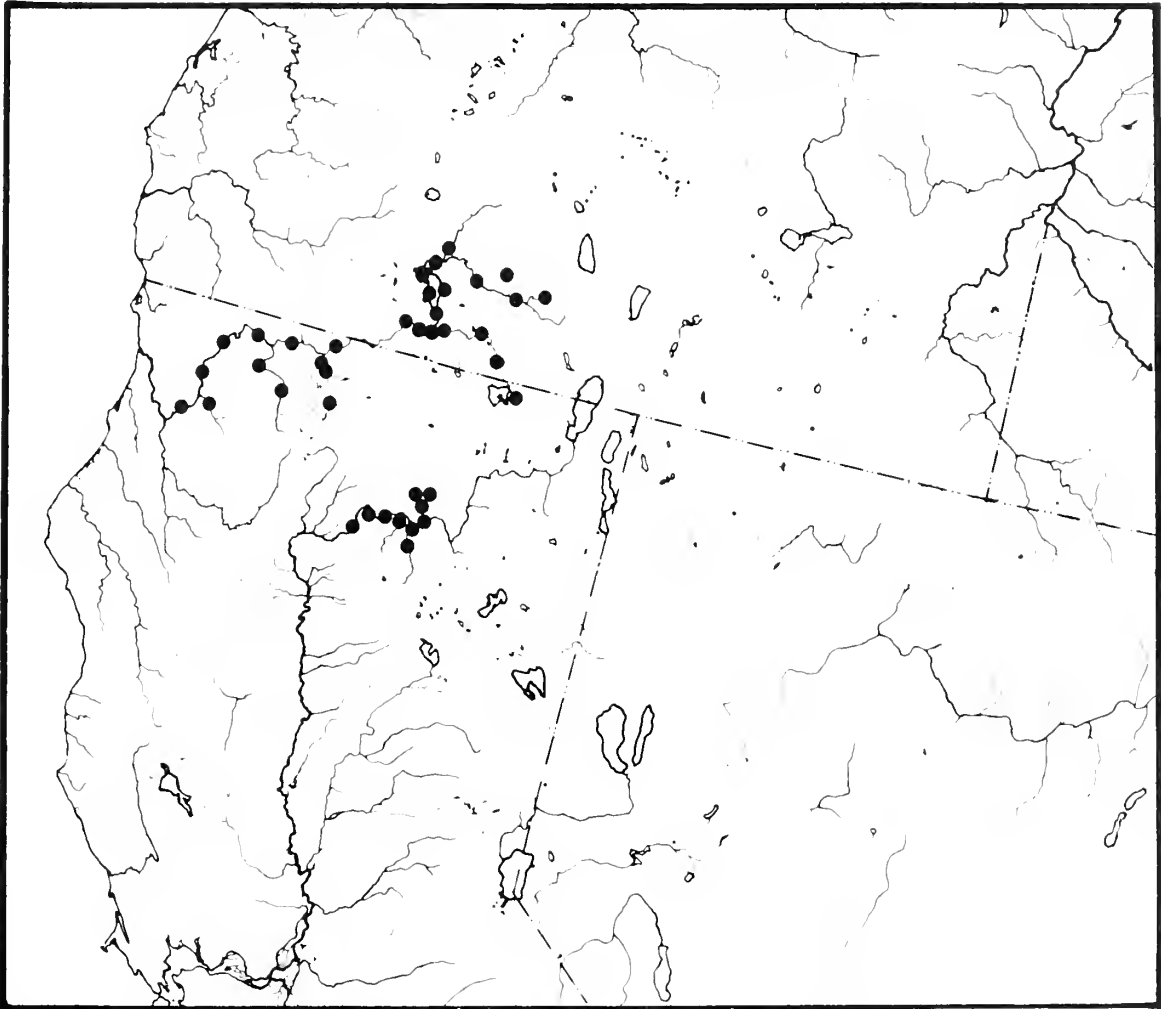
Order Perciformes
Family Cottidae

TYPE LOCALITY: Upper Klamath Lake, near Klamath Falls, OR (Gilbert 1898. Bull. U.S. Fish Comm. [1897] 17:1-13).

SYSTEMATICS: *Cottus macrops* of Pit River system, CA, was synonymized with *C. klamathensis* of Klamath River system, CA and OR, by Robins and Miller (1957. Calif. Fish Game 43:213-33). However, distinctive ecology of Pit River form and numerous minor differences in meristics of the two forms indicate some sort of taxonomic separation may be warranted.



CA: Siskiyou Co., Scott River, 85 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Klamath River form found throughout Klamath River system and in Lost River, CA and OR, in wide variety of habitats including upper Klamath and Agency lakes. Pit River form found in Fall River, lower Hat Creek, and Pit River between these two tributaries in areas where there are soft-bottomed runs of clear, cold water. Collected in water ranging from 8-24°C. Most abundant sculpin in lakes and reservoirs of region.

ADULT SIZE: 40 - 80 mm SL.

BIOLOGY: Similar to other *Cottus* (Moyle 1976. *Inland Fishes of California*; R. A. Daniels, unpubl.). Spawns during spring. Females have high fecundity for sculpins, containing as many as 1184 eggs (Bond 1963. Ph.D. diss., Univ. Michigan).

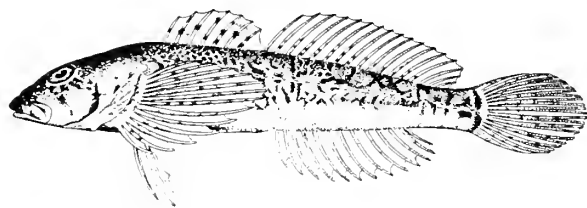
Compiler: P. B. Moyle. July 1978.

Cottus leiopomus Gilbert and
Evermann
Wood River sculpin

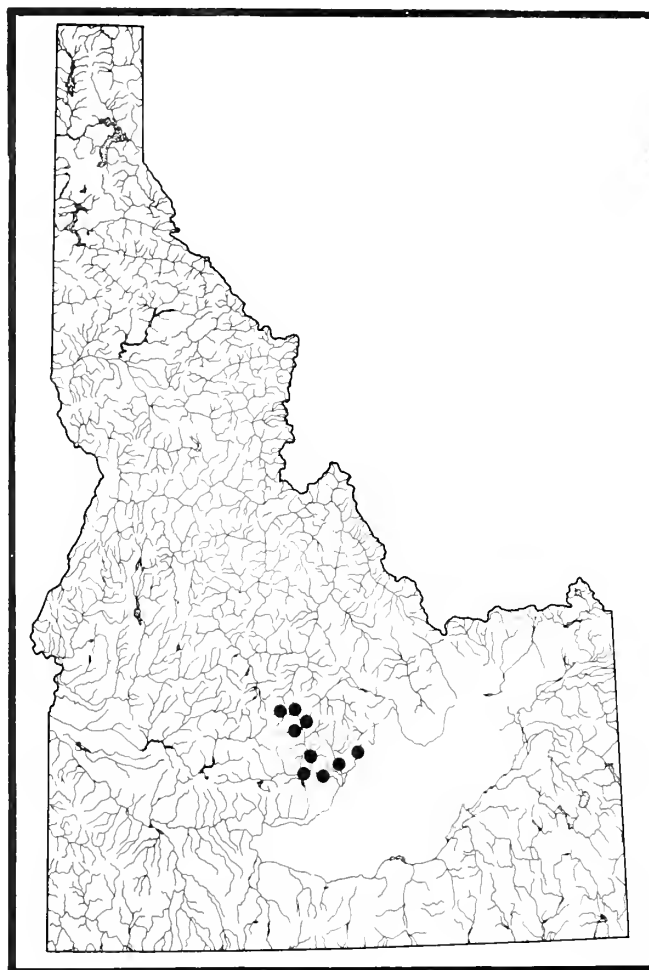
Order Perciformes
Family Cottidae

TYPE LOCALITY: Upper Little Wood River near Shoshone, Lincoln Co., ID (Gilbert and Evermann 1895. Bull. U.S. Fish Comm. [1894] 14:169-207).

SYSTEMATICS: Considered closely related to *C. beldingi* (Hubbs and Schultz 1932. Occas. Pap. Mus. Zool. Univ. Mich. 242:1-9). Bailey and Bond (1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27) listed it in *C. bairdi* species group.



ID: Little Wood River, near
Shoshone, ca. 71 mm SL
(Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Mainly in small to medium-sized streams with cool, clear waters and swift current. Found in riffle areas with gravel-rubble substrate. Distribution now confined to upper Little Wood River and tributaries, and Big Wood River and tributaries upstream from Magic Reservoir, Blaine Co., ID.

ADULT SIZE: 60-90 mm SL.

BIOLOGY: No published accounts known.

Compiler: R. L. Wallace. April 1978.

Cottus marginatus (Bean)
Margined sculpin

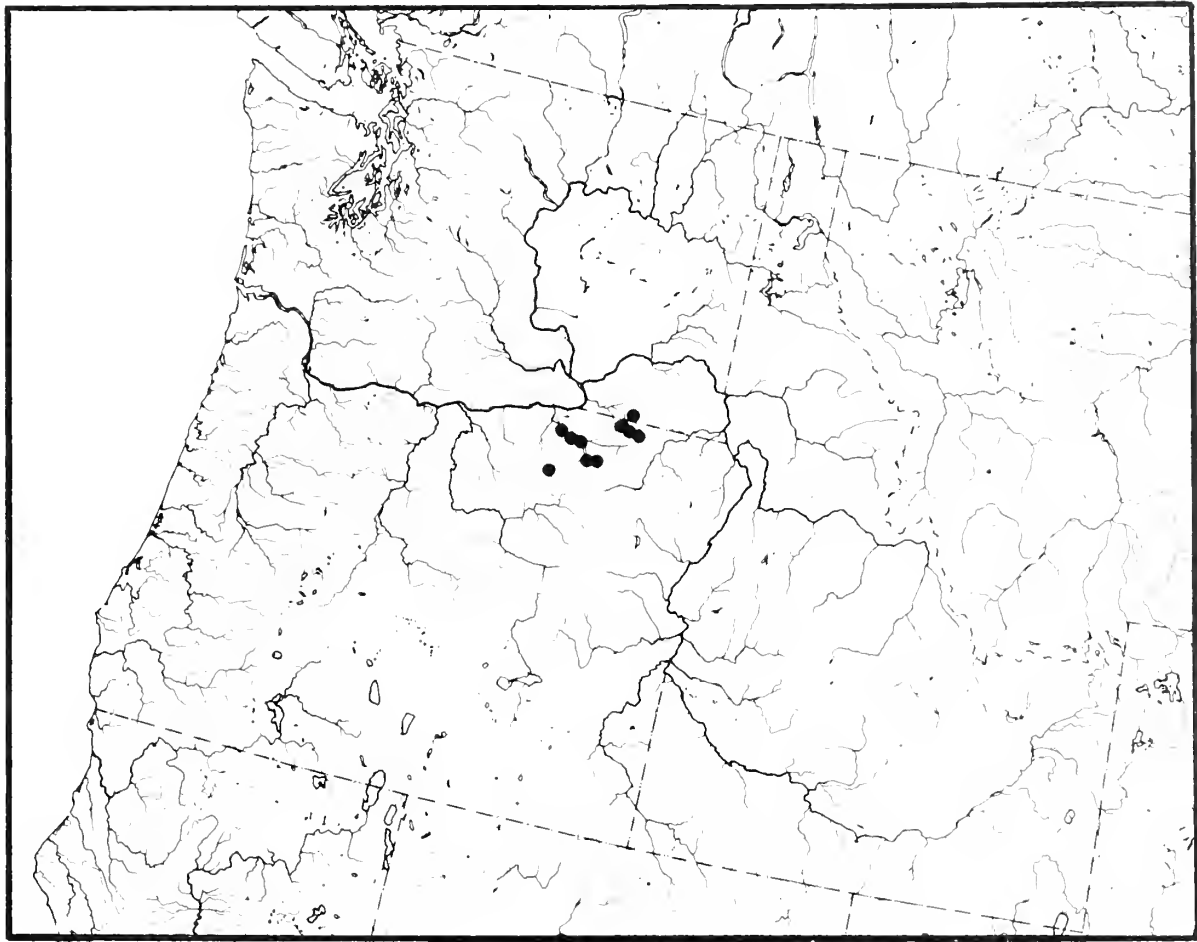
Order Perciformes
Family Cottidae

TYPE LOCALITY: "Tributaries of Walla Walla River," Walla Walla Co., WA (Bean 1881. Proc. U.S. Natl. Mus. 4:26-29).

SYSTEMATICS: Placed in *Uranidea* by Bean, but that genus synonymized with *Cottus* by Kendall (1904. Bull. U.S. Fish Comm. 22:353-68), Gill (1908. Smithson. Misc. Collect 52:101-116) and Hubbs (1919. Occas. Pap. Mus. Zool. Univ. Mich. 65:1-9). Placed in "*C. asper* species group" by Bailey and Bond (1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27) and considered derivative of a form like *C. perplexus* by Bond (1963. Ph.D. diss., Univ. Michigan).



(Bond 1973)



DISTRIBUTION AND HABITAT: Locally common but confined to Umatilla River drainage of OR and Walla Walla River drainage of OR and WA. Appears adaptable to wide variety of currents and substrates (Bond 1963).

BIOLOGY: Little information available (Bond 1963 ; Bond 1974. Oreg. State Univ. Agr. Exp. Stan. Spec. Rep. 205). Part of range lies within an area subjected to insecticide spraying for tussock moth control.

ADULT SIZE: ca. 50-130 mm TL.

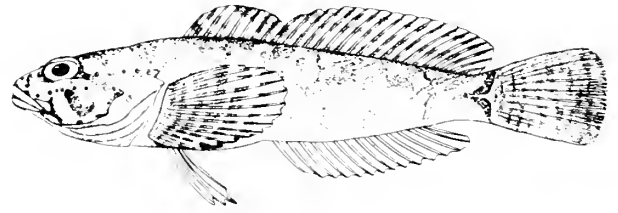
Compiler: K. M. Howe. July 1978.

Cottus perplerus Gilbert and
Evermann
Reticulate sculpin

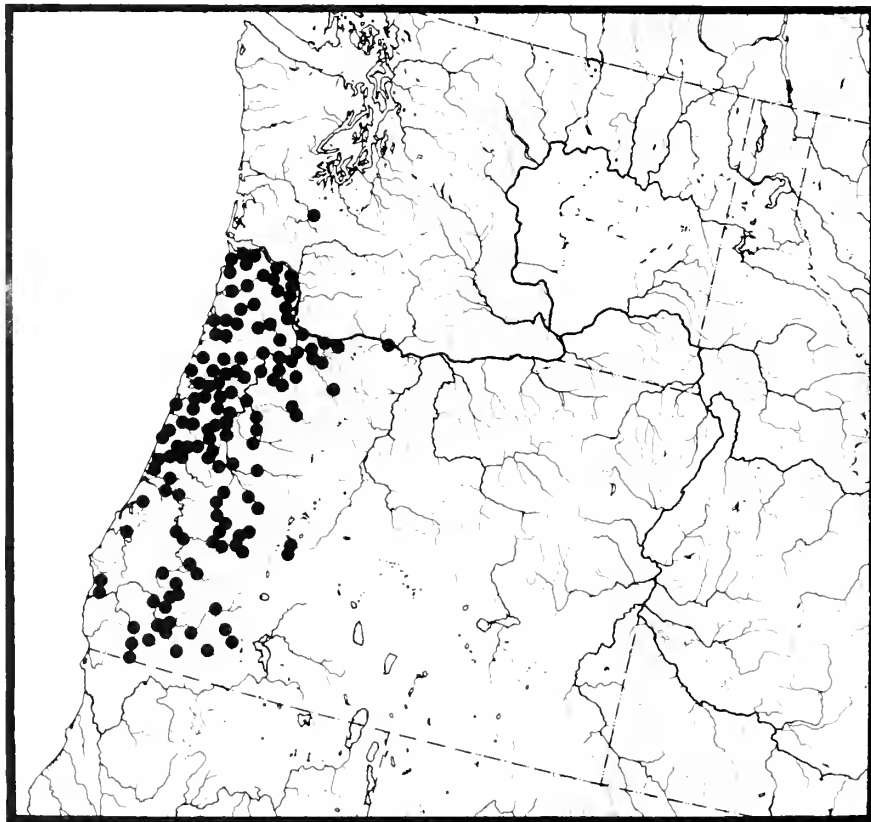
Order Perciformes
Family Cottidae

TYPE LOCALITY: Skookcumchuck River, near Chehalis, WA (Gilbert and Evermann 1895. Bull. U.S. Fish. Comm. [1894] 14: 169-204).

SYSTEMATICS: Synonymized with *C. gulosus* by Snyder (1908. Bull. U.S. Bur. Fish. 27:153-89). Most workers followed Snyder until Robins and Miller (1957. Calif. Fish Game 43:213-33) resurrected *C. perplerus* to specific status. Taxonomic confusion still exists (Bond 1963. Ph.D diss., Univ. Michigan; Reimers and Bond 1967. Copeia:541-50). Complex under study by Howe, Oregon State University.



(Bond 1973. *Key to the Fishes of Oregon*)



DISTRIBUTION AND HABITAT: Coastal streams of OR and WA from Rogue River north; Willamette River drainage and upper Deschutes River drainage of OR; lower Columbia River drainage of OR-WA; portions of Puget Sound drainage, WA (see Bond 1963; Reimers and Bond 1967; Bond 1973. Calif. Fish Game 59:93-94). Inhabits variety of habitats; most often in pools but this may be result of interactions with other sculpins (Bond 1963). Ecology and local distribution under study (T. R. Finger, Oregon State Univ.).

ADULT SIZE: ca. 50-110 mm TL.

BIOLOGY: Limited information available (Bond 1963; Phillips and Claire 1966. Trans. Am. Fish. Soc. 95:210-12; Krohn 1968. M.S. thesis, Oregon State Univ.). Some workers (Patten 1971. Am. Midl. Nat. 85:493-506; Pasch and Lyford 1972. Trans. Am. Fish. Soc. 101:377-81) appear to have misidentified other *Cottus* species as *C. perplerus*. Spawns in the spring.

Compiler: K. M. Howe. July 1978.

***Cottus pitensis* Bailey and Bond**
Pit sculpin

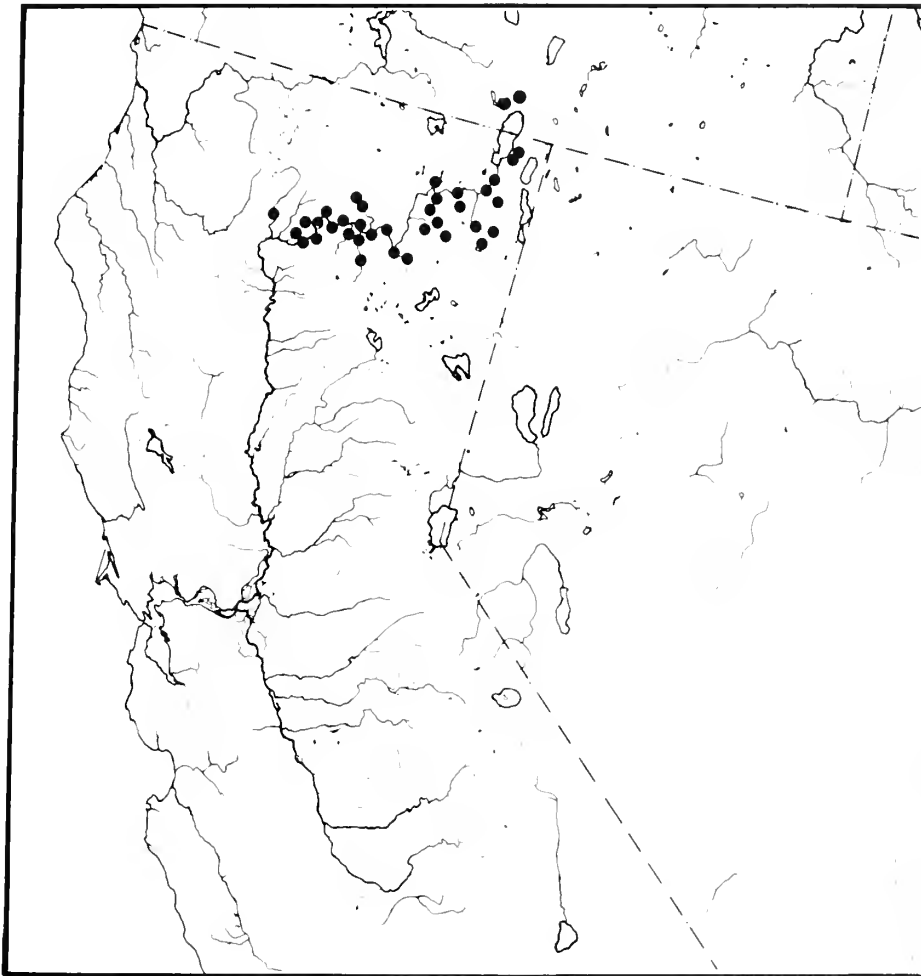
Order Perciformes
Family Cottidae

TYPE LOCALITY: North Fork of Pit River near Alturas, Modoc Co., CA (Bailey and Bond 1963. Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27).

SYSTEMATICS: Probably derived from *C. gulosus* (Bailey and Bond 1963).



CA: Modoc Co., Rush Creek,
10 cm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: Found throughout Pit River system, Sacramento drainage, from tributaries to Goose Lake, in OR (Lake Co.), to Squaw Valley Creek, Shasta Co., CA. Also known from upper Sacramento River (Bailey and Bond 1963).

BIOLOGY: Typical of stream dwelling *Cottus* (Moyle 1976. *Inland Fishes of California*; Li and Moyle 1976. Bull. South. Calif. Acad. Sci. 75:111-18).

ADULT SIZE: 40-100 mm SL.

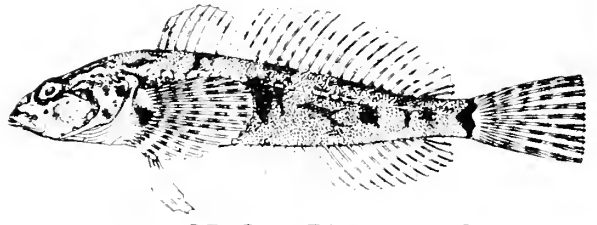
Compiler: P. B. Moyle. September 1978.

Cottus princeps Gilbert
Klamath Lake sculpin

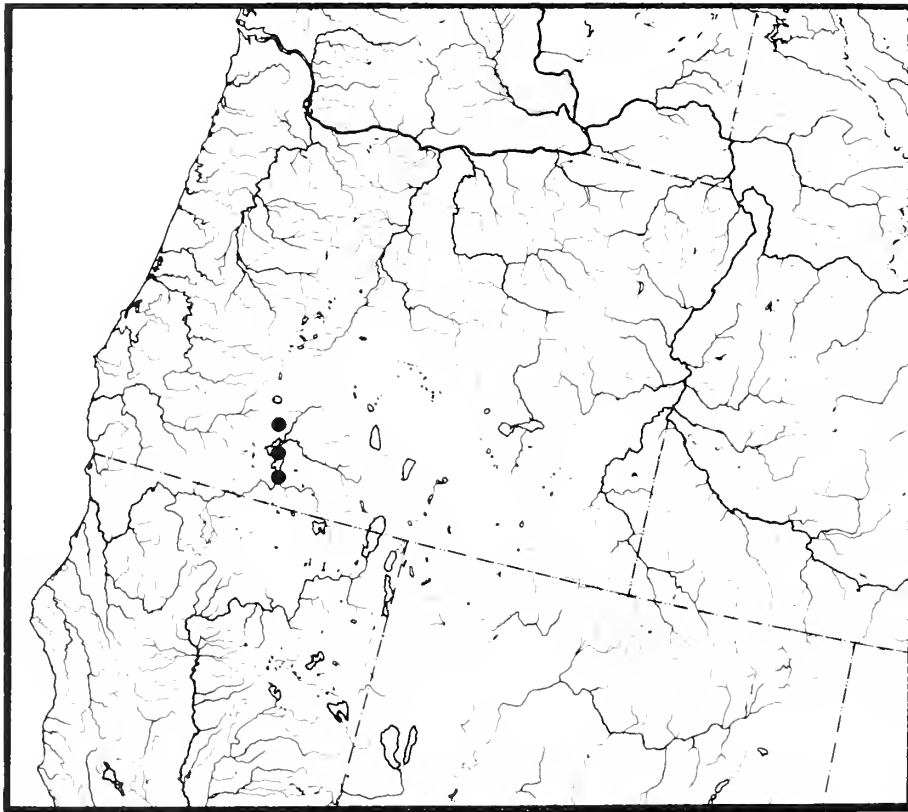
Order Perciformes
Family Cottidae

TYPE LOCALITY: Upper Klamath Lake, OR (Gilbert 1898. Bull. U.S. Fish. Comm. [1897] 17:1-13).

SYSTEMATICS: Includes *C. evermanni* (Gilbert 1898) from Lost River, OR (Bailey and Dimick 1949. Occas. Pap. Mus. Zool. Univ. Mich. 513:1-18). Other taxonomic data in Robins and Miller (1957. Calif. Fish Game 43:213-33). Variation in *C. princeps* suggests hybridization with *C. klamathensis* or *C. tenuis*, or undescribed species similar to *C. princeps* (Bond unpubl. data).



OR: Lost River, near Lostine, ca. 49 mm SL (Jordan and Evermann 1900).



DISTRIBUTION AND HABITAT: Restricted to Upper Klamath and Agency lakes, OR, and adjacent irrigation canals. Although recorded by Gilbert (1898) from Lost River, OR, as *C. evermanni*, not collected there in recent times (unpubl. data on collections from 1949 to 1975; Contreras 1973. M.S. thesis, Univ. Nevada, Reno). Abundant in the lakes but rare outside; appears to be strictly lacustrine.

ADULT SIZE: ca. 40-70 mm TL.

BIOLOGY: Very little known. May be unusual in spawning fall-winter. Robins and Miller (1957) noted that females taken November 1896 were ripe with eggs.

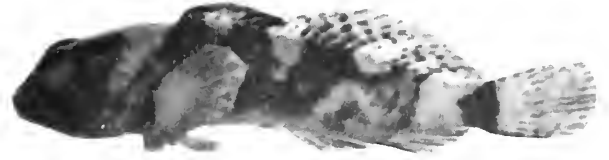
Compiler: K. M. Howe. July 1978.

Cottus pygmaeus Williams
Pygmy sculpin

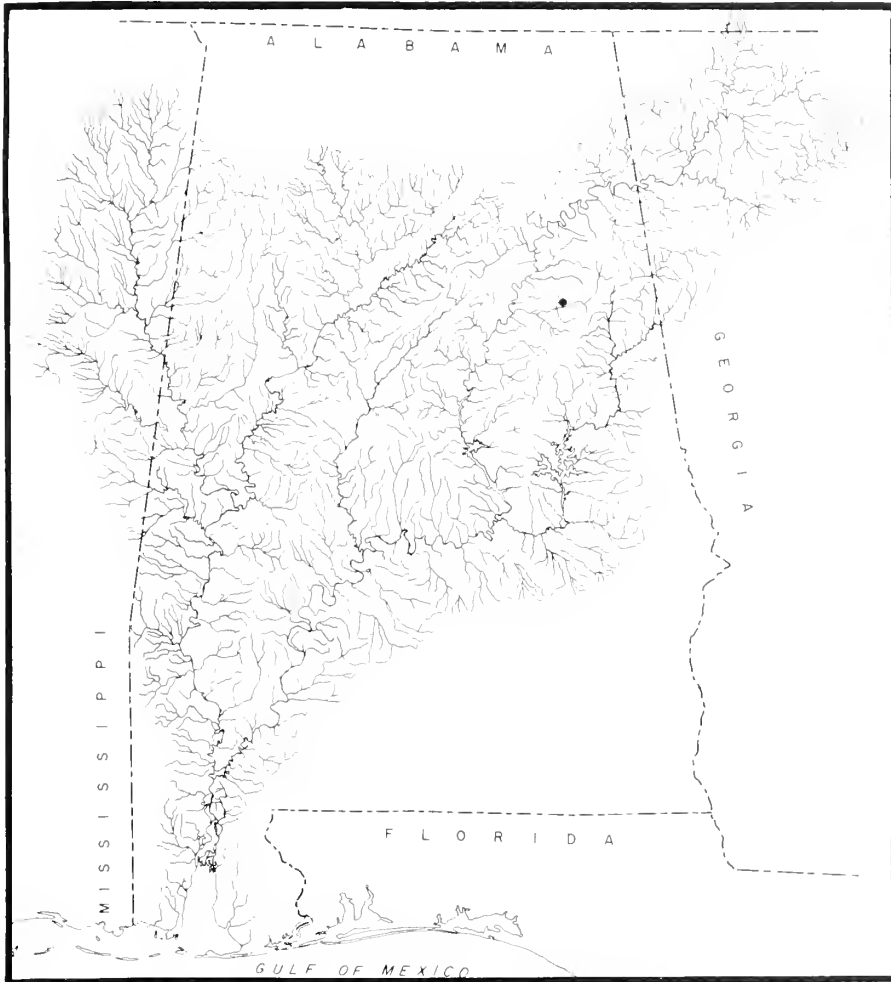
Order Perciformes
Family Cottidae

TYPE LOCALITY: Coldwater Spring (T16S, R7E, SE $\frac{1}{4}$, Sec. 29), Calhoun Co., AL (Williams 1968, Copeia:334-42).

SYSTEMATICS: Member of *C. bairdi* species-group as defined by Bailey and Bond (1963, Occas. Pap. Mus. Zool. Univ. Mich. 634:1-27), but differs from *C. bairdi* and *C. caroliniae zopherus* in a number of ways, including absence of palatine teeth, lower number of fin-ray elements and distinctive coloration.



AL: Calhoun Co., Coldwater Spring, 31 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Known only from type locality. Coldwater Spring flows from a fault zone at average rate of 32 million gal/day, and year around water temperature is $17 \pm 1^\circ\text{C}$. Spring impounded, forming pool about 1.5 m deep. Spring run, 12-15 m wide, 152 m long and up to 0.6 m deep, flows into Coldwater Creek, then into Choccolocco Creek, a tributary to Coosa River. *Myriophyllum* and *Ceratophyllum* are dominant plants in spring pool, but *Nasturtium* is dominant along edges of spring run. *Fontinalis* and *Fissidens* are present on surface of rocks. Spring run substrate predominantly rock and gravel.

ADULT SIZE: 38 mm SL maximum.

BIOLOGY: Spawning probably occurs throughout year, peaking April to August. Eggs laid beneath flat rocks. Juveniles found in areas of slow current with gravel bottom. Food of adults is isopods, amphipods, gastropods, and trichopterans. Young feed on chironomid larvae, copepods, and ostracods (McCaleb 1973, M.S. thesis, Auburn Univ.).

Compiler: H. T. Boschung, July 1979.

***Cottus rhotheus* (Smith)**
Torrent sculpin

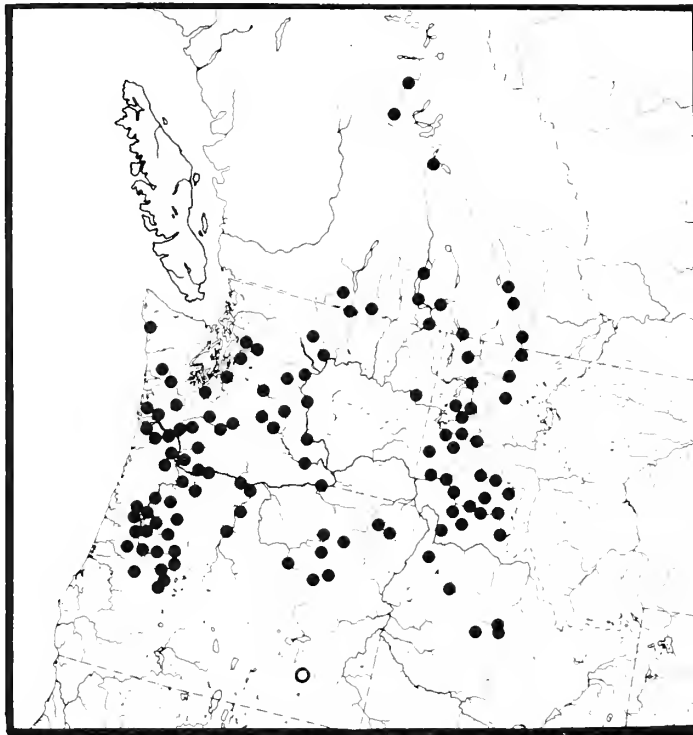
Order Perciformes
Family Cottidae

TYPE LOCALITY: Spokane Falls, WA
(Smith 1882. Proc. U.S. Natl. Mus. 5:347-48).

SYSTEMATICS: Bailey and Dimick (1949. Occas. Pap. Mus. Zool. Univ. Mich. 513:1-18) and McAllister and Lindsey (1961. Bull. Natl. Mus. Can. Contrib. Zool. [1959] 172:66-89) discussed the extensive geographic variation. Coastal specimens have shorter head and less complete lateral line than inland specimens, and reduced or absent body prickles. Variation in number of dorsal rays and caudal vertebrae noted by Northcote (1950. B.A. thesis, Univ. British Columbia). At least morphologically related to *C. caroliniae* of southeastern United States, and shares some features with *C. ricei* (McAllister and Lindsey 1961).



ID: Coeur d'Alene River, 81
mm SL (NCSM).



Open circle transplanted population

DISTRIBUTION AND HABITAT: Columbia and Fraser river drainages in OR, WA, ID, northwest MT, and BC. Also in coastal drainages from Puget Sound basin, WA, to Nehalem River, OR. Bond (1963. Ph.D. diss., Univ. Michigan) noted presence in Fish Lake, Harney Co., OR, but believed it accidentally introduced when trout stocked. Primarily stream species, but occurs in lakes. Typically in middle reaches of streams, in swift waters with stable, gravel to rubble bottom, but in WA occurs farther upstream than any other fish species and may even be isolated above falls (Schultz 1930. Copeia:14-15).

ADULT SIZE: 55-80 mm SL.

BIOLOGY: Spawns about May and June. Food consists mainly of aquatic insects, but fish become more important as size increases, and at 70 mm or larger are almost the exclusive prey (Scott and Crossman 1973. *Freshwater Fishes of Canada*). Northcote (1954. Copeia:25-28) and Bond (1963) studied ecology. Patten (1971a. Am. Midl. Nat. 85:493-506) studied spawning and fecundity in two populations from WA. Predation on Pacific salmon and steelhead trout fry investigated by Patten (1962. Trans Am. Fish. Soc. 91:427-29; 1971b. J. Fish. Res. Board Can. 28:1352-54; 1975. Fish. Bull. 73: 931-34; 1977. Fish. Bull. 75:457-59).

Compiler: R. L. Wallace. August 1978.

Cottus ricei (Nelson)
Spoonhead sculpin

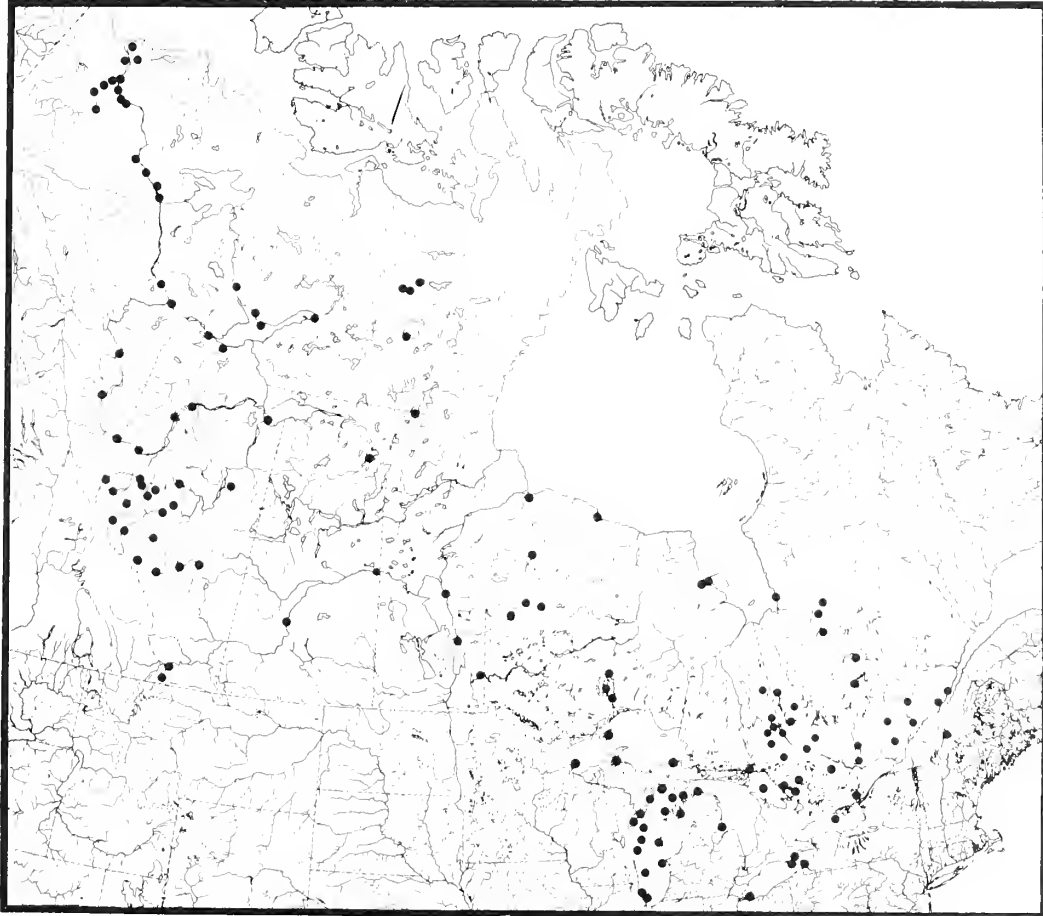
Order Perciformes
Family Cottidae

TYPE LOCALITY: Lake Michigan off Evanston, IL (Nelson 1876. Bull. Ill. Lab. Nat. Hist. 1:40).

SYSTEMATICS: One of the more distinctive species of *Cottus* in North America. Most closely allied to the Palearctic *C. sibiricus*, *C. spinulosus*, and *C. gobio* (McAllister and Lindsey 1966. Bull. Nat. Mus. Canada 172: 66-89). Clinal northwest decrease in amount of vertebrae and anal, dorsal, and pectoral fin rays exists.



QU: Lake Heney, male,
100 mm SL (NMC).



DISTRIBUTION AND HABITAT: Lakes and rivers from Great Lakes and St. Lawrence drainage northwest through Hudson Bay and Arctic drainage, to mouth of McKenzie River. McPhail and Lindsey (1970. Bull. Fish. Res. Board Can. 173:1-381) hypothesized survival during glaciation in an upper Mississippi refugium, but some evidence suggests an additional refugium in upper Missouri. In muddy and clear rivers and lakes, and occasionally in brackish water as evidenced by occurrence on Akimiski Island in James Bay. Found at depths intermediate between *C. cognatus* and *Myoxocephalus thompsoni*, usually 20 to 50 m (137 m maximum), in Great Lakes, and between 15-20 m and 4-8°C (rarely to 18°C) in eastern ON and western QU (Dadswell 1972. J. Fish. Res. Board Can. 29:545-53).

ADULT SIZE: 45-75 mm SL, 110 mm SL maximum.

BIOLOGY: Spawning time unknown, but males caught August 1 in Pemichangan Lake, Gatineau Co., QU, exuded milt under light pressure (Delisle and Van Vliet 1968. J. Fish. Res. Board Can. 25:2733-37). A young specimen 27.5 mm TL was trawled from Lake Erie at 22 m on August 21 (Fish 1932. Bull. Bur. Fish 47:293-398). Food apparently plankton and aquatic insects. Preyed on by lake trout and burbot (Scott and Crossman 1973. *Freshwater Fishes of Canada*).

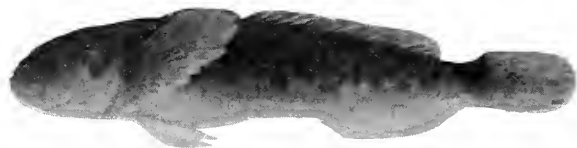
Compilers: D. E. McAllister and B. Parker.
September 1978.

Cottus tenuis (Evermann and Meek)
Slender sculpin

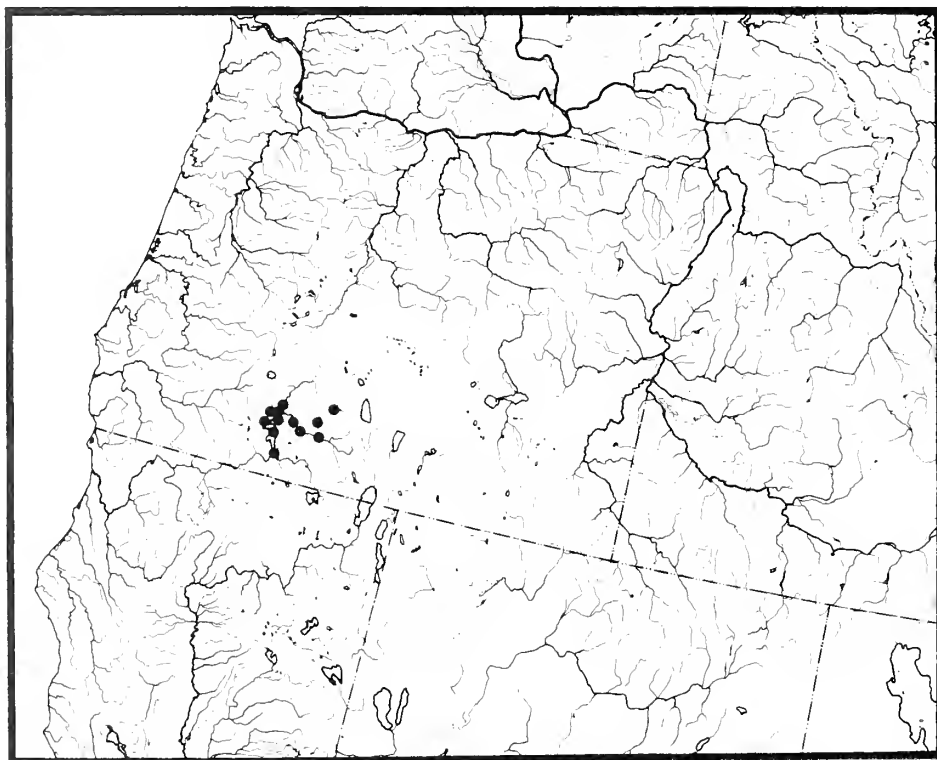
Order Perciformes
Family Cottidae

TYPE LOCALITY: Lower end of Upper Klamath Lake, near Klamath Falls, OR (Evermann and Meek 1898. Bull. U.S. Fish. Comm. [1897] 17:15-84).

SYSTEMATICS: Originally in genus *Uranidea*, later synonymized with *Cottus* by Kendall (1904. Bull. U.S. Fish. Comm. 22:353-68), Gill (1908. Smithson. Misc. Collect. 52:101-16), and Hubbs (1919. Occas. Pap. Mus. Zool. Univ. Mich. 65:1-9). Robins and Miller (1957. Calif. Fish Game 43: 213-33) provided some taxonomic data concerning species.



OR: Klamath Co., Wood River,
male, 60 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Restricted to Upper Klamath and Agency lakes and their tributaries, and Klamath Irrigation Canal of OR. Has been taken over a variety of substrates and from both still and swift waters.

ADULT SIZE: ca. 50-90 mm TL.

BIOLOGY: Limited information available (Bond 1963. Ph.D. diss., Univ. Michigan).

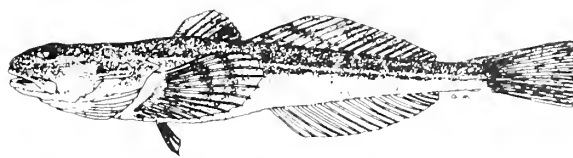
Compiler: K. M. Howe. July 1978.

Leptocottus armatus Girard
Pacific staghorn sculpin

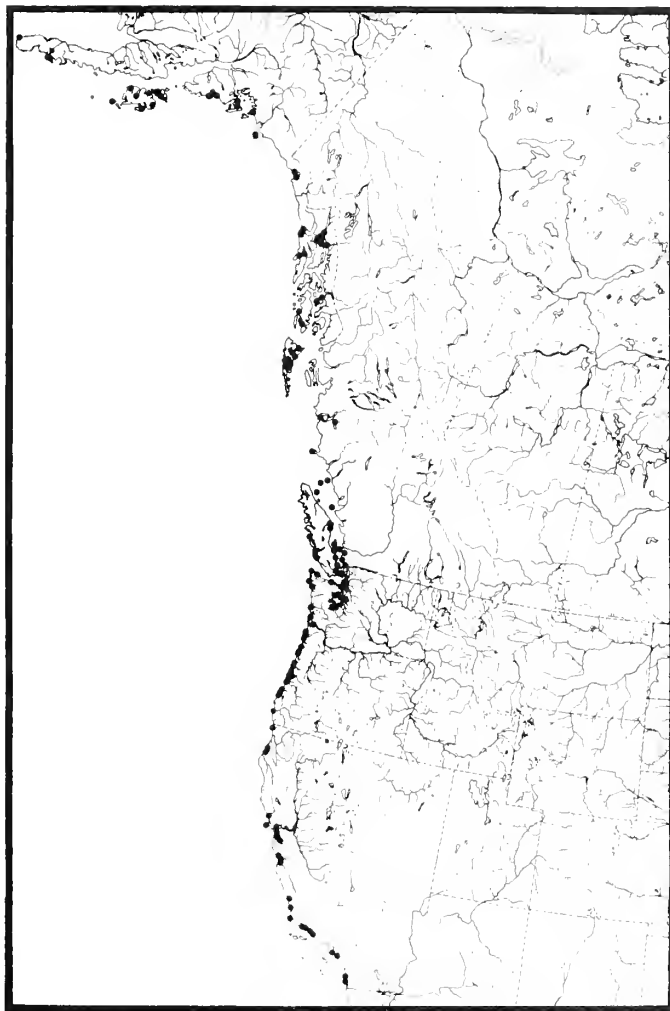
Order Perciformes
Family Cottidae

TYPE LOCALITY: San Francisco, CA (Girard 1854. Proc. Acad. Nat. Sci. Phila. [1854-55] 7:129-40).

SYSTEMATICS: Hubbs (1921. Occas. Pap. Mus. Zool. Univ. Mich. 94:1-7) and Hubbs et al. (1979. Occas. Pap. Cal. Acad. Sci. 133: 1-54) recognized northern nominate subspecies and southern subspecies, *L. a. australis*, from Ventura, CA, but latter not recognized by Bolin (1944. Stan. Ichthyol. Bull. 3:1-135).



CA: Mendocino Co., Navarro River, 91 mm SL (Moyle 1976).



DISTRIBUTION AND HABITAT: From San Quintin Bay, Baja California, north to Kodiak Island and west to Unga Island, Aleutians, AK. In shallow coastal waters or lower reaches of rivers in salinities of 0-34 ppt.

ADULT SIZE: 250-300 mm TL, maximum 460 mm.

BIOLOGY: Lays 2,000 to 11,000 eggs in January and February in CA (Moyle 1976. *Inland Fishes of California*). Newly hatched juveniles often move into fresh water where they eat amphipods, some varied worms, and insect larvae. Adults feed on crabs, shrimp and fish. Seldom attains age of more than three years.

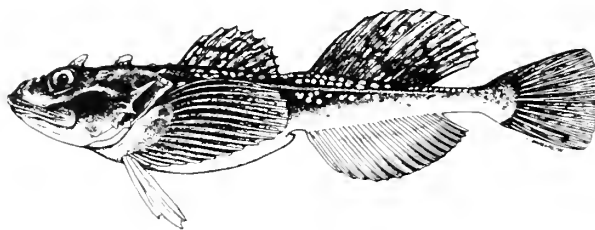
Compilers: D.E. McAllister and A. Marchand. February 1980.

Myoxocephalus quadricornis
(Linnaeus)
Fourhorn sculpin

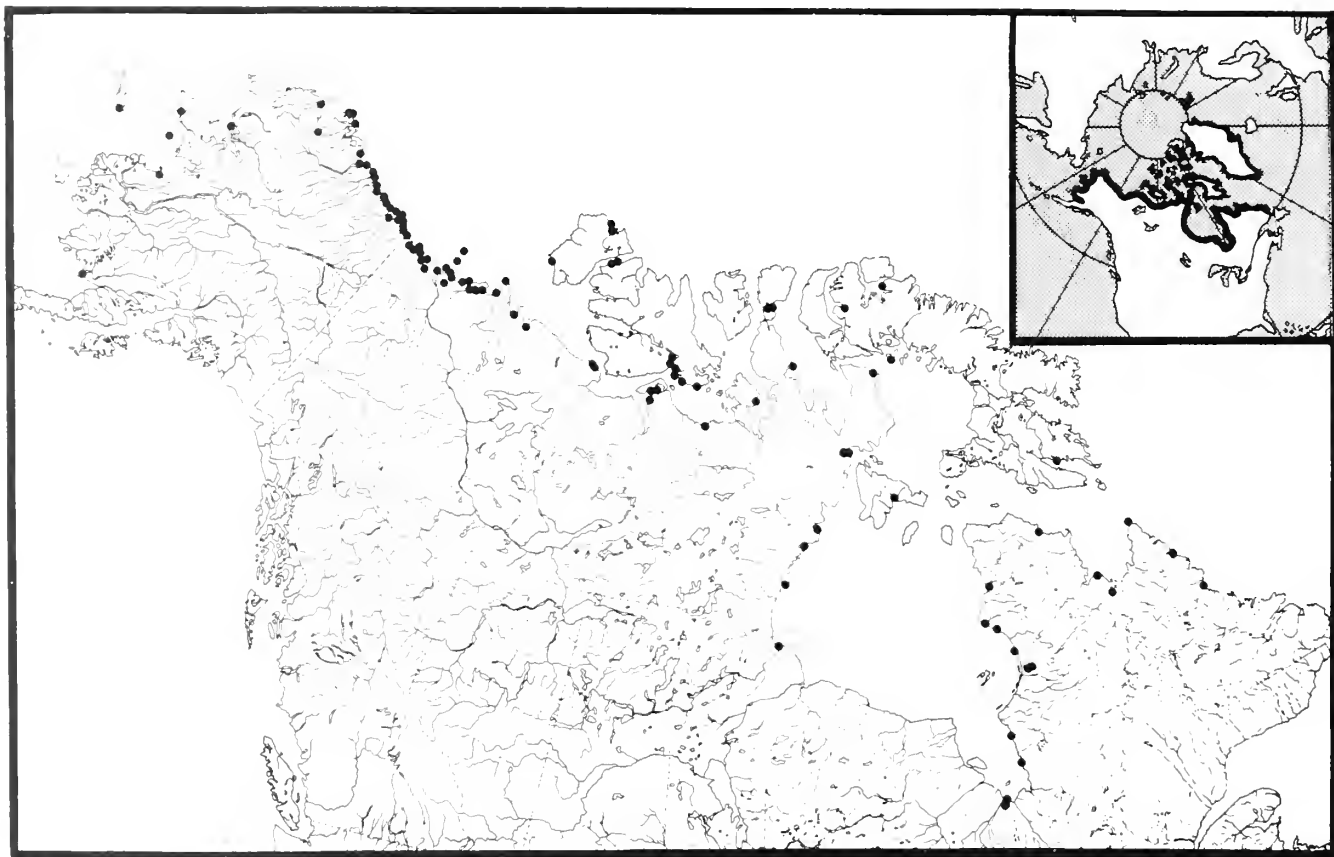
Order Perciformes
Family Cottidae

TYPE LOCALITY: Baltic Sea (Linnaeus 1758. *Systema naturae*, Laurentii Salvii, Holmiae, 10 ed., 1:1-824).

SYSTEMATICS: Walters (1955. Bull. Am. Mus. Nat. Hist. 155:259-368) recognized two subspecies, Baltic *M. q. quadricornis* and circumpolar *M. q. polaris*, but additional study required to verify distinctness. McAllister and Aniskowicz (1976. J. Fish. Res. Board Can. 33:2792-99) discussed variation between freshwater relicts and coastal form.



NT: King William Island,
Peterson Bay, female,
231 mm SL (NMC).



DISTRIBUTION AND HABITAT: Circumpolar marine from Barents Sea to Bering Sea in Palearctic; AK to Labrador, and James Bay to Ellesmere Island in Nearctic; Greenland; absent from Iceland, Norway, and Spitzbergen. In salt, brackish, and fresh shallow coastal waters from 20 m to intertidal zone; in estuaries; up rivers as far as 150 km from the sea; and as resident relicts in some lakes. Adults benthic, larvae pelagic. Individuals of coastal form occasionally run for distance up rivers, but apparently do not form resident populations in fresh water.

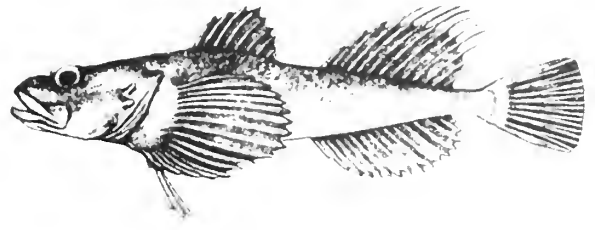
ADULT SIZE: up to 340 mm TL, usually smaller.

BIOLOGY: Ripe and spent fish taken in March in Mackenzie delta, NT (Percy 1975. Beaufort Sea Tech. Rept. 8:1-18). Eggs hatch in May and June (Khan and Faber in Blaxter [ed.] 1973. *The Early Life History of Fish*: 703-12). Free swimming larvae found along shorelines and in shallow pelagic regions. Reaches age of 14 years. Adults feed on crustaceans, annelids, pelecypods, odonata, and fish. Species preyed on by gulls, *Lota lota*, *Myoxocephalus scorpius*, *Salvelinus alpinus*, and *Lycodes*.

Compiler: D. E. McAllister. February 1978.

***Myoxocephalus thompsoni* (Girard)**
Deepwater sculpin

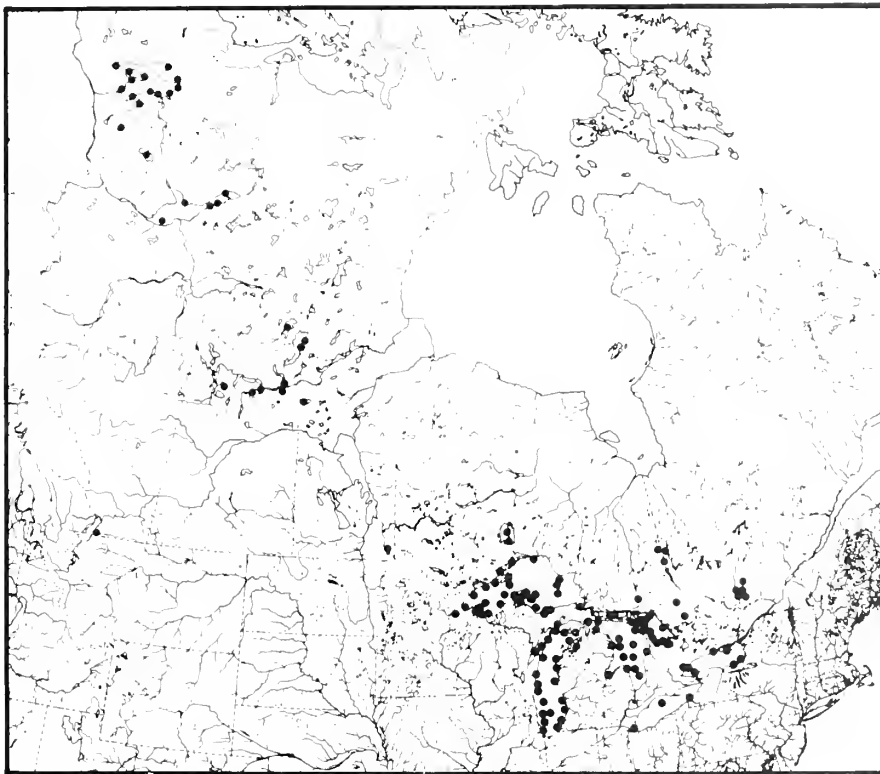
Order Perciformes
Family Cottidae



ON: Bruce Co., Lake Huron,
male, 133 mm SL (NMC).

TYPE LOCALITY: Lake Ontario off Oswego, Oswego Co., NY (Girard 1852. *Smithson. Contrib. Knowl.* 3:1-80).

SYSTEMATICS: Derived from *M. quadricornis* at beginning of Wisconsin glaciation or earlier. Taxonomy and distribution treated by McAllister (1959. *Natl. Mus. Can. Bull.* 172:44-65) and McAllister and Aniskowicz (1976. *J. Fish. Res. Board Can.* 33: 2792-99). Discriminant function analysis by McAllister et al. (1978. *Curator* 21:63-91) permits separation of all specimens of the two species previously treated by Bailey et al. (1970. *Am. Fish. Soc. Spec. Publ.* 6:1-150) as conspecific. Champagne et al. (1979. *Can. J. Earth Sci.*) reported a 10,000 year old fossil from Ottawa, Canada.



DISTRIBUTION AND HABITAT: In deeper, cooler mainland lakes within or near basins of formerly glacial lakes, from Great Lakes and Ottawa River drainages west and north to Upper Waterton Lake, AT, and Great Bear Lake, NT. Distributions in lakes Superior, Michigan, and Huron not accurately represented by map, because extensive areas have not been surveyed; probably inhabits all parts where depth is suitable. Adults and juveniles benthic. Occupies entire floor of Great Bear Lake from depths of 3 m to maximum (Johnson 1975. *J. Fish. Res. Board Can.* 32:1989-2004). In Great Lakes generally avoids shallower water, occurring mainly at depths of 50 m to maximum. Usually found in waters less than 5° C, although observed at temperatures to 13.2° C. Abundant

in some lakes, e.g., Superior, Michigan, and Huron, but has almost disappeared from Lake Ontario.

ADULT SIZE: 50-100 mm SL, 199 mm SL maximum.

BIOLOGY: Spawning habits poorly known. In lakes Superior and Michigan, evidently occurs in winter, mostly at depths greater than 50 m. Pelagic larvae appear in spring (Wells 1973. *Great Lakes Fish. Comm. Tech. Rep.* 20:1-55; unpubl., U. S. Fish and Wildlife Service). Adults feed mostly on *Pontoporeia* and *Mysis*. Preyed upon by *Salvelinus namaycush* and *Lota lota*.

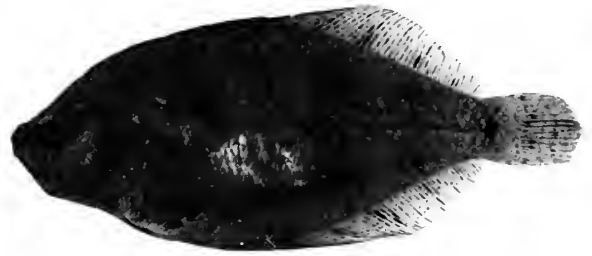
Compilers: D. E. McAllister and L. Wells.
August 1979.

Citharichthys spilopterus Günther
Bay whiff

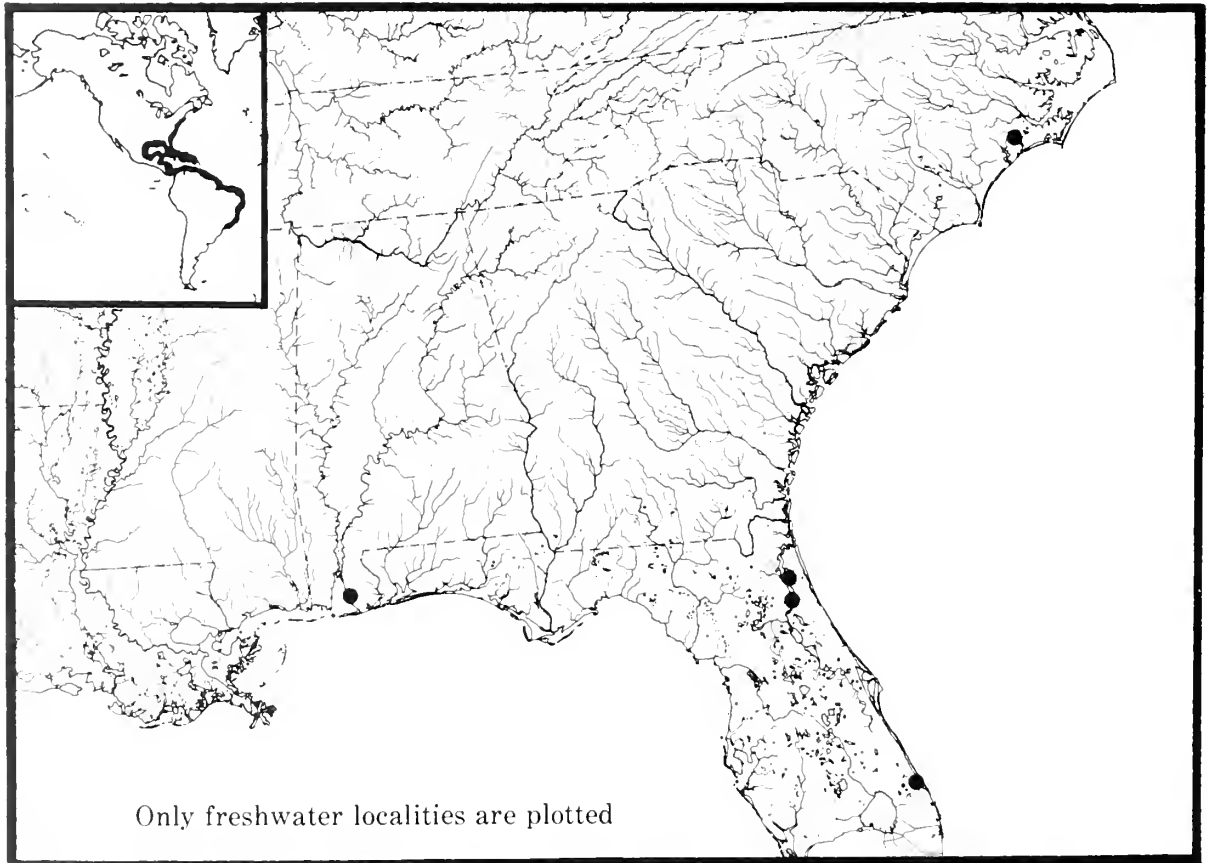
Order Pleuronectiformes
Family Bothidae

TYPE LOCALITY: New Orleans (Günther 1862. *Catalogue of the Fishes in the British Museum* Vol. 4:1-534).

SYSTEMATICS: Subfamily Paralichthinae. Closely related to *C. gilberti* of eastern Pacific (Norman 1934. *A Systematic Monograph of the Flatfishes (Heterosomata)*, Vol. 1:1-459).



FL: Martin Co., St. Lucie Inlet,
109 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Ranges from NJ to Brazil, throughout northern Gulf of Mexico and much of Caribbean. Reported to depths of 73.2 m, but most common in waters shallower than 37 m. Generally occurs over sandy bottoms. Young usually appear in estuaries in late spring. Adults move to deeper or offshore waters in cold months (Gunter 1938. *Ecol. Monogr.* 8:314-46; Gunter 1945. *Publ. Inst. Mar. Sci. Univ. Tex.* 1:1-190). May enter fresh water (especially juveniles); does so regularly in Central America (Gilbert and Kelso 1971. *Bull. Fla. State Mus. Biol. Sci.* 16:1-54) but only occasionally in United States.

ADULT SIZE: ca. 150 mm TL maximum.

BIOLOGY: Stickney et al. (1974. *Fish. Bull.* 72:515-25) reported mysid shrimp, *Neomysis americanus*, to be dominant food of GA specimens. Tucker (1978. M.S. thesis. North Carolina State Univ.) described larval development. Spawning in early spring suggested (Gunter and Hall 1963. *Gulf Res. Rep.* 1:189-307; Swingle 1971. *Ala. Mar. Resour. Bull.* 5:1-123). Comprehensive biological data lacking, especially concerning age and growth.

Compiler: S. W. Ross. May 1979.

Paralichthys lethostigma Jordan and
Gilbert
Southern flounder

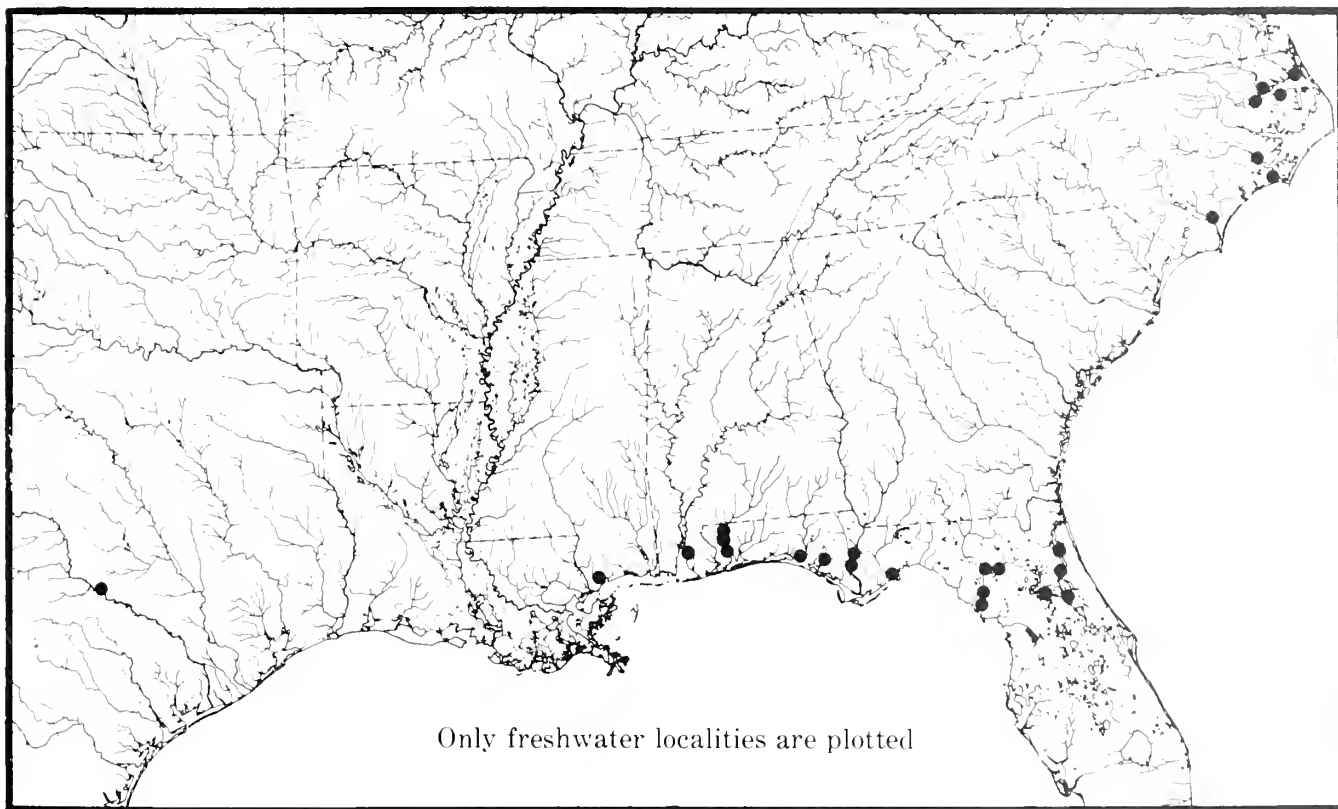
Order Pleuronectiformes
Family Bothidae

TYPE LOCALITY: Not designated (Jordan and Gilbert *in* Jordan and Meek 1884. Proc. U.S. Natl. Mus. 7:235-37). Indian River, FL, established as type locality by neotype designation (Ginsburg 1952. Fish. Bull. 71, U.S. Fish Wildl. Serv. 52:267-351).

SYSTEMATICS: Subfamily Paralichthinae (Norman 1934. *A Systematic Monograph of the Flatfishes (Heterosomata)*, Vol. 1:1-459), subgenus *Paralichthys* (Ginsburg 1952). Closely related to *P. dentatus* and *P. albigitta*. Systematics of genus reviewed by Ginsburg (1952).



FL: Putnam Co., St. John's
River, 144 mm SL (NCSM).



DISTRIBUTION AND HABITAT: Coastal and estuarine waters from Albemarle Sound, NC, to Jupiter Inlet, FL, and from Caloosahatchee estuary, FL, to northern Mexico (range not continuous around southern tip of FL). Apparently most abundant in western Gulf of Mexico (Topp and Hoff 1972. Fla. Dept. Nat. Resour. Mar. Res. Lab.:1-135). Seems to prefer muddy substrates throughout range. Often enters fresh waters; stocked in freshwater lakes near Austin, TX (E. G. Simmons, pers. comm.).

ADULT SIZE: 300 mm TL, 659 mm SL maximum.

BIOLOGY: Extensive biological data lacking. North Carolina specimens reported to consume mostly mysid shrimp and fishes (Powell 1974. M.S. thesis, Univ. North Carolina, Chapel Hill). Salinity effects on growth of juveniles examined by Deubler (1960. Bull. Mar. Sci. 10:338-45) and Deubler and White (1962. Copeia: 468-69). Stokes (1977. Tex. Parks Wildl. Dept. Tech. Ser. 25:1-37) presented data on food habits, age and growth, sexual development, and distribution in Aransas Bay area, TX.

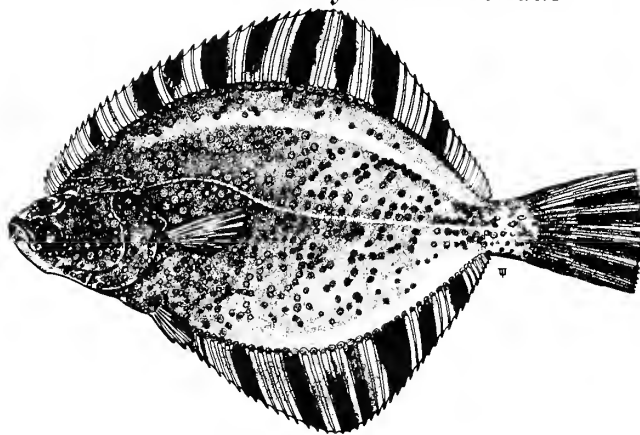
Compiler: S. W. Ross. May 1979.

Platichthys stellatus (Pallas)
Starry flounder

Order Pleuronectiformes
Family Pleuronectidae

TYPE LOCALITY: Kamchatka, Aleutian, and Kuril islands (Pallas 1814. *Zoogeographica Rosso-Asiatic* 3:1-423; date from Opinion 212, Int. Comm. Zool. Nomencl.).

SYSTEMATICS: No definitive systematic study. Strong cline in proportion of sinistral individuals, 50-60% from CA to southeast AK, 68% Kodiak Island and Alaska Peninsula, and 100% in Japan (Hart 1973. *Pacific Fishes of Canada*).



(NMC)



DISTRIBUTION AND HABITAT: Coastal areas from Santa Ynez River, CA, north to AK, east along Arctic coast of Canada to Bathurst Inlet, west to Sea of Japan. Generally in low-gradient tidal areas having sandy or muddy bottoms. Particularly common in Sacramento-San Joaquin delta and in lower parts of coastal streams. Recently known to enter San Luis Reservoir and O'Neill Forebay, Merced Co., CA, via California Aqueduct (Moyle 1976. *Inland Fishes of California*). Movement in and out of fresh water may be seasonal (Ganssle 1966. Calif. Dept. Fish Game Fish Bull. 133:64-94).

ADULT SIZE: ca. 200-950 mm SL.

BIOLOGY: Benthic. Feeds on crabs, polychaetes, molluscs, amphipods, and copepods in salt water and estuaries (Orcutt 1950. Calif. Dept. Fish Game Bull. 78:1-64; Porter 1964. M.S. thesis, Humboldt State Univ.; Ganssle 1966). Freshwater diet may consist of insect larvae, such as Tipulidae (Porter 1964). May spawn in fresh water (Radtke 1966. Calif. Fish Game Fish Bull. 136:115-29), but generally in shallow salt water, November through February (Orcutt 1950). Males spawn after third year at about 350 mm SL.

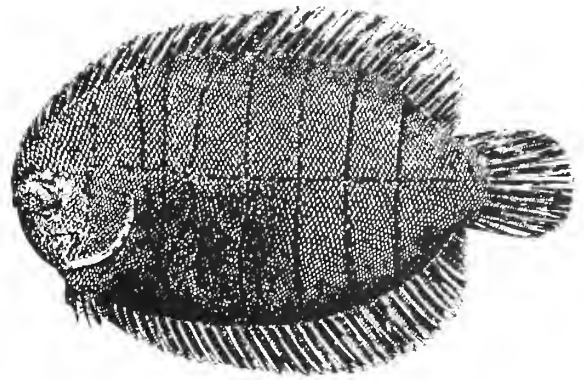
Compilers: B. Martin, W. A. Pursley and D. E. McAllister. July 1979.

Trinectes maculatus (Bloch and
Schneider)
Hogchoker

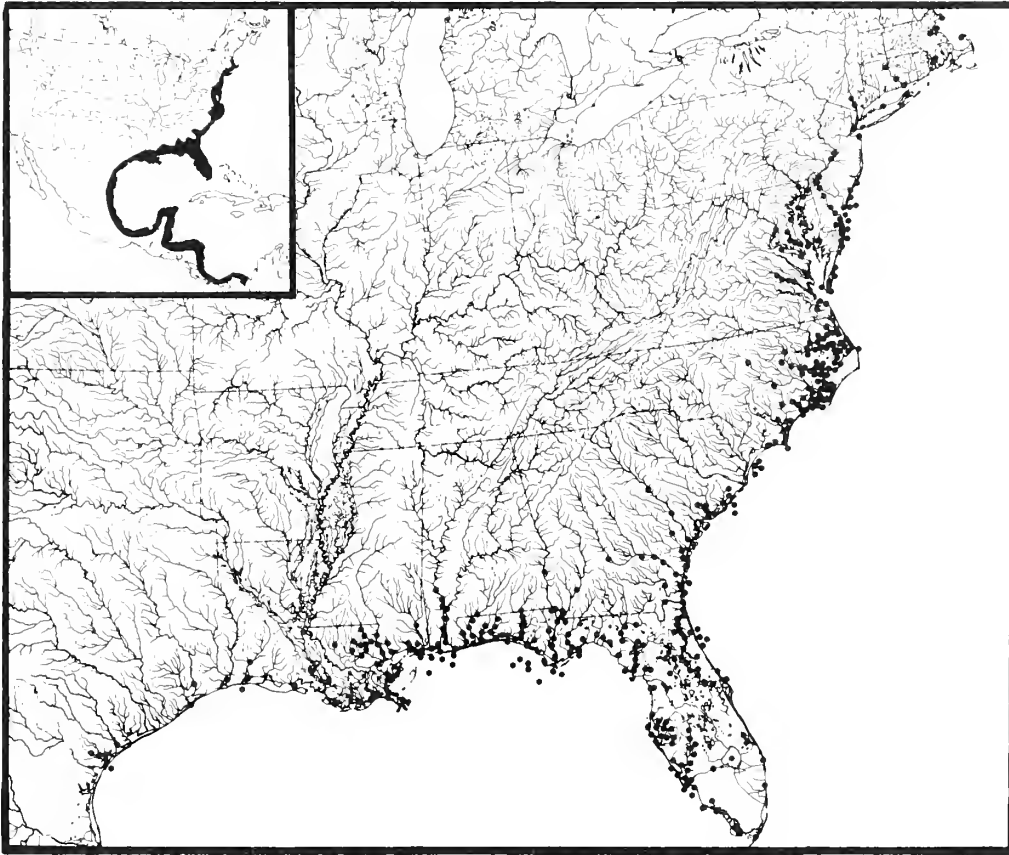
Order Pleuronectiformes
Family Soleidae

TYPE LOCALITY: "Habitat ad Tranguebariam" (India) (Bloch and Schneider 1801. *Systema Ichthyologiae Iconibus CX Illustratum*, 1-584). Type locality is certainly in error, since this species is confined to the western North Atlantic and adjacent coastal rivers.

SYSTEMATICS: Two subspecies, *T. m. fasciatus* and *T. m. maculatus*, have been recognized (Hubbs and Allen 1943. *Proc. Florida Acad. Sci.* 6:110-30). Hubbs (1932. *Proc. Biol. Soc. Wash.* 45:19-22) showed that *T. maculatus* has priority over *Archirus fasciatus*, but the latter appeared in subsequent literature for many years.



ca. 122 mm SL (Jordan and
Evermann 1900).



DISTRIBUTION AND HABITAT: Ascends coastal rivers into freshwater as far upstream as the Fall Line as normal part of life cycle. Adults most often found in estuarine and marine habitats. Ranges from Cape Ann, MA, to Panama in continental waters; most common from Hudson River south.

ADULT SIZE: 80-140 mm TL.

BIOLOGY: Dovel et al. (1969. *Chesapeake Sci.* 10:104-19) presented data on abundance, distribution, and seasonality. Spring spawning began at 20°C and peaked at 25°C in salinities greater than 9 ppt; larvae moved upstream into fresh waters after hatching.

Spring downstream movement to spawning areas and fall upstream migrations occurred at least through fourth year, with progressive age-related preference for higher salinities. Koski (1978. *Trans. Am. Fish. Soc.* 107: 449-54) and Mansueti and Pauly (1956. *Copeia*: 60-62) reported on age, growth, and maturity. Effects of temperature, salinity, and food availability on feeding and growth discussed by Peters and Boyd (1972. *J. Exp. Mar. Biol. Ecol.* 7:201-07). Early development summarized by Lippson and Moran (1974. *Manual for Identification of Early Developmental Stages of Fishes of the Potomac River Estuary*).

Compiler: G. H. Burgess. October 1978.

GLOSSARY

- Adipose fin* - a small, fleshy, rayless fin located behind the dorsal fin in some fishes (see figure 1).
- Allopatric* - pertaining to related populations or species that occupy mutually exclusive (but often adjacent) geographical areas (see sympatric).
- Ammocoete* - larval stage of lampreys.
- Amphipods* - crustaceans of the order Amphipoda, characterized by a compressed body, first thoracic segment fused with the head, and no true carapace; includes scuds and sideswimmers.
- Anadromous* - ascending rivers and streams from the sea to spawn in fresh waters; opposite of catadromous.
- Anal fin* - fin on the median ventral line, usually directly behind the anus (see figure 1).
- Annulus* - a circular mark or area formed on scales of fish; used to recognize a year's growth.
- Anterior* - pertaining to the front or forward part.
- Barb* - a hooklike, sometimes serrated projection, found on pectoral and dorsal fin spines of carp and catfishes.
- Barbel* - a slender, elongate, fleshy (sometimes whiskerlike) protuberance from or near the lips or chin, usually with touch or taste receptors.
- Basin* - refers here to a major group of interconnected drainages; e.g., Ohio basin, Mississippi basin, and Missouri basin.
- Benthic* - living on or very near the bottom.
- Catadromous* - descending rivers and streams from fresh water to spawn in the sea; opposite of anadromous.
- Caudal fin* - tail fin (see figure 1).
- Chironomids* - true flies of the midge family Chironomidae.
- Class* - a major taxonomic category; subdivision of a phylum, consisting of a number of orders.
- Cline* - gradual and progressive change of a structure or character along a geographic gradient; e.g., increase in vertebral number northwards.
- Coastal* - refers here to tidal areas, estuaries, or the actual coast.
- Copepods* - small crustaceans of the subclass Copepoda, characterized by rigid, sclerotized, cylindrical segments, and a true head with five pairs of appendages.
- Crustaceans* - members of the class Crustacea, phylum Arthropoda; all have a hard exoskeleton, usually with a carapace and telson; includes crayfish, crabs, barnacles, shrimp, water fleas, and others.
- Disjunct* - populations of organisms geographically isolated from a species' main range.
- Disk width* - distance between pectoral fin tips across the dorsal surface of skates and rays (see *Dasyatis sabina*).
- Dorsal* - pertaining to the back or upper surface.
- Dorsal fin* - soft rayed or spinous fin on the median dorsal surface (see figure 1).
- Drainage* - refers here to an interconnected major group of streams and tributaries entering estuaries or marine habitats; part of a major river basin (such as the Mississippi basin), or the largest rivers (such as the Ohio River).

Endangered - in danger of extinction; here used for those species included in the U.S. List of Endangered Fauna and Endangered and Threatened Plant Species of the United States, under the Endangered Species Act of 1973 (Public Law 93-205).

Endemic - unique to a particular region or locality.

Established - refers here to a self-sustaining (reproducing) population.

Estuary - the body of tidal water where fresh and salt waters mix to form brackish waters (adjective: estuarine).

Euryhaline - able to tolerate a wide range of salinities, i.e. fish that can freely move between salt and fresh waters.

Exotic - foreign; not native to North America.

Extinct - no longer represented by living individuals; refers to a species or other taxon.

Extirpated - exterminated on a local basis (political or geographic part of range); refers to a population or populations.

Family - a taxonomic category; subdivision of an order, consisting of a genus or a number of genera.

Fauna - the collective assemblage of animal life of a particular area or time.

Fingerling - a young fish, usually late in the first year.

Fork length - distance from tip of snout or lip to posterior-most part of middle ray of caudal fin (see figure 1).

Fry - a young fish, at the age when yolk has been consumed and the fish is actively feeding.

Gastropods - molluscs of the class Gastropoda, characterized by usually having a spiral, one piece shell (absent in some); snails, limpets, slugs, and relatives.

Genus - a taxonomic category; subdivision of a family, including one or more species with certain characteristics in common (plural:genera).

Herbivore - an organism that feeds primarily on vegetation (adjective:herbivorous).

Hybrid - refers here to the offspring resulting from a cross between individuals of two different natural populations (usually distinct species).

Ichthyology - the study of fishes.

Intergrade - refers here to the offspring resulting from a cross between individuals of two different subspecies.

Introduced - refers here to non-native species (exotics) that have been released in North American waters, and occasionally to native species transplanted outside their natural ranges.

Introgression - the spread of genes of one species into the gene pool of another species, by hybridization and subsequent backcrossing of hybrid individuals with one or both parental forms.

Lacustrine - pertaining to lakes.

Larva - the early, immature form of an animal that changes structurally as it becomes an adult (plural larvae).

Lateral line - a linear series of small, porelike organs along the side of the body (part of the acoustico-lateralis sensory system) that lead into sensory canals (see figure 1).

Littoral - refers to the area along the shore of bodies of water.

Niche - the special combination of chemical, physical, and biological factors needed by a species for survival; the role a species plays in its community.

Omnivore - an organism that feeds on both plant and animal material (adjective:omnivorous).

Ostracods - small crustacea of the subclass Ostracoda, characterized by a bivalve shell enclosing an indistinctly segmented body.

Oviparous - refers to organisms whose eggs are deposited, develop, and hatch in an external environment; opposite of viviparous.

Ovoviviparous - refers to organisms whose large, yolky eggs are retained in the body and hatch in the oviduct; no placenta is involved, young are born alive.

Pectoral fin - uppermost of the paired fins, and usually the farthest forward. (see figure 1).

Pelagic - of open waters, usually the sea, but may also refer to lakes.

Pelvic fins - paired fins, usually lying below and/or posterior to the pectoral fins (see figure 1); absent in some fishes.

Peritoneum - membrane lining the abdominal cavity.

Pharyngeal teeth - bony, toothlike projections originating from the fifth gill arch in the families Cyprinidae and Catostomidae; often used as a taxonomic character.

Phenotype - the characteristics (appearance) of an individual, the result of interactions between its genotype and the environment.

Piscivorous - fish-eating.

Plankton - usually microscopic plants and animals, whose movements are generally dependent on currents.

r - the intrinsic or natural rate of population increase.

Redd - a gravel nest.

Relict - an isolated population, survivor of a formerly more widespread species or of a nearly extinct group.

Slope - used here to refer collectively to all drainages on their surfaces (except for Mississippi River drainage proper on the Gulf slope); e.g. the Atlantic slope.

Smolt - a life stage of salmonid fishes (usually 1-3 years of age) turning silvery prior to migrating from a stream or lake to the sea, or from a stream to a large lake.

Species - the fundamental taxonomic category; subdivision of a genus; group of organisms which naturally or potentially interbreed, are reproductively isolated from other such groups, and are usually morphologically separable from them.

Standard length - distance from tip of lip or snout to posterior end of caudal skeleton and caudal flexure (see figure 1).

Stocked - continually replaced, normally refers to nonreproducing fish populations.

Stream capture - erosional process whereby a portion of a river or tributary is diverted by and into another river system.

Subspecies - a taxonomic category, subdivision of a species; a group of local populations inhabiting a geographic subdivision of the species range, and differing taxonomically from other populations of the species.

Sympatric - pertaining to populations of related species occupying identical or overlapping ranges and not separated by a geographic barrier (see allopatric).

Synonym - an additional scientific name for the same taxon.

Syntopic - found in the same microhabitats.

System - refers here to a group of interconnected streams within a drainage.

Threatened - a form or forms likely to become Endangered within the foreseeable future if certain conditions (principally ecological) continue to deteriorate.

Total length - distance from the forward most portion of the lip as snout to the posterior end of the tail fin (when the lobes of the tail fin are squeezed together).

Tubercle - a small projection or lump; usually refers here to keratinized or osseous structures developed during the reproductive period, i.e. breeding tubercles.

Tuberculate - having tubercles.

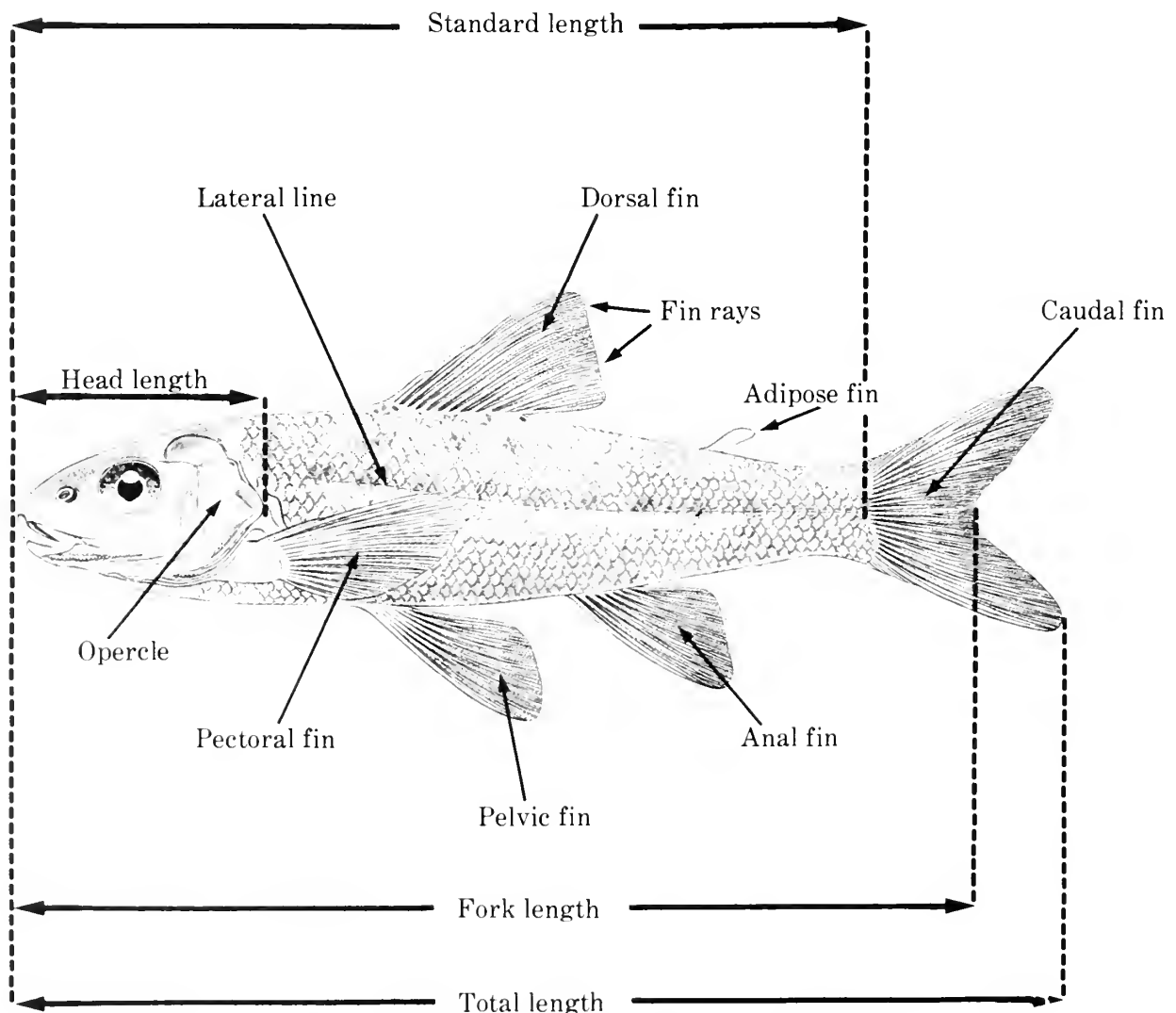
Transplanted - to transfer from one location to another; normally refers to fishes introduced outside their natural ranges.

Type - taxonomic term referring to a particular species (usually the first named).

Type locality - the locality or site from which the holotype, lectotype, or neotype specimens were taken.

Vent - the external opening of the alimentary canal; the anus.

Weberian apparatus - a series of ossicles that conduct vibrations or pressure changes from air bladder to ear, involving the first four or five fused vertebrae behind the head, and restricted to species of the orders Cypriniformes and Siluriformes.



APPENDIX A
BOOKS CITED IN ACCOUNTS

- Abbott, C. C. 1884. *A Naturalist's Rambles About Home*. New York.
- Agassiz, J. L. R. 1850. *Lake Superior*. Its physical character, vegetation, and animals, compared with those of other and similar regions. Boston: Gould, Kendall, and Lincoln. 428 pp.
- Alvarez, J. 1970. *Peces Mexicanos*. Inst. Nac. Inv. Viol. Pesq. Ser. Inv. Pesq. 166 pp.
- Balon, (ed.) 1980. Charrs: *Salmonid Fishes of the genus Salvelinus*. Hingham, Massachusetts: Kluwer Boston Inc.
- Berg, L. S. 1948. *Freshwater Fishes of the U.S.S.R. and adjacent countries*. Guide to the fauna of the U.S.S.R. Number 27. Volume 1, 4th ed. Akad. Nauk SSSR Zool. Inst., Moscow. Translated from Russian by Israel Program for Scientific Translations. 1962. Office of Technical Services, U. S. Department of Commerce, Washington, DC. 504 pp.
- Berg, L. S. 1949. *Freshwater Fishes of the U.S.S.R. and adjacent countries*. Guide to the fauna of the U.S.S.R. Number 27, Volume 2, Akad. Nauk SSSR Zool. Inst. Moscow.
- Bigelow, H. B. and W. C. Schroeder. 1948. Sharks, pp. 59-546, in *Fishes of the Western North Atlantic*, Memoir Sears Foundation for Marine Research, Number 1 (Part 1), Yale University.
- Bigelow, H. B. and W. C. Schroeder. 1953. Sawfishes, Guitarfishes, Skates, and Rays, pp. 1-514, in *Fishes of the Western North Atlantic*, Memoir Sears Foundation for Marine Research, Number 1 (Part 2), Yale University.
- Blair, W. F. (ed.) 1961. *Vertebrate Speciation*. A University of Texas symposium. Austin, Texas: University of Texas Press. 642 pp.
- Blair, W. F., A. P. Blair, P. Brodkorb, F. R. Cagle, and G. A. Moore. 1957. *Vertebrates of the United States*. New York: McGraw-Hill Book Company, Inc. 2nd edition. 616 pp.
- Blaxter, J. H. S. (ed.) 1974. *In Early Life History of Fish*. Proceedings of an International symposium held at Dumstaffnage Marine Research Laboratory, Oban, Scotland (1973). New York: Springer-Verlag.
- Bloch, M. E. and J. G. Schneider. 1801. *Systema Ichthologiae*, iconibus ex illustratum. Berlin. 584 pp.
- Breder, C. M., Jr., and D. E. Rosen. 1966. *Modes of Reproduction in Fishes*. Garden City, N.Y.: Natural History Press. 941 pp.
- Calhoun, A. (ed.) 1966. *Inland Fisheries Management*. Sacramento, California: California Fish and Game Department.
- Carlander, K. D. 1969. *Handbook of Freshwater Fishery Biology*, Volume 1. Ames, Iowa: The Iowa State University Press. 752 pp.
- Carlander, K. D. 1973. *Handbook of Freshwater Fishery Biology*, Volume 2. Ames, Iowa: The Iowa State University Press. 431 pp.
- Clepper, H. E., and R. H. Stroud (eds.). 1975. *Blackbass Biology and Management*. Washington, DC: Sport Fishing Institute. 534 pp.
- Crossman, E. J. 1976. *Quetico Fishes*. Life Sciences Miscellaneous Publication. Toronto, Canada: The Royal Ontario Museum. 86 pp.
- Cuvier, G. A. and M. A. Valenciennes. 1828-1849. *Histoire Naturelle des Poissons*. Paris. 22 Volumes.
- Cuvier, G. L. C. F. D. 1834. *The Animal Kingdom*, arranged in conformity with its organization, with supplementary additions to each order, by Edward Griffith. Volume 10. The class Pisces arranged by the Baron Cuvier with supplementary additions by Edward Griffith and Charles Hamilton Smith. London: Whittaker & Company. 680 pp.

- DeKay, J. E. 1842. *Natural History of New York*. I. Zoology. Reptiles and Fishes. Part 4-Fishes. Albany, N.Y.: Appleton & Company, and Wilby and Putnam. 415 pp.
- Dill, 1964. *Handbook of Physiology*.
- Eddy, S. 1957. *How to Know the Freshwater Fishes*. Dubuque, Iowa: W. C. Brown Company. 253 pp.
- Fremling, C. R. 1979. Biology and functional anatomy of the freshwater drum, *Aplodinotus grunniens* Rafinesque. Laboratory Manual. Fort Atkinson, Wisconsin: Nasco. 46 pp.
- Fritzsche, R. A. 1978. *Development of Fishes of the Mid-Atlantic Bight*. Volume 5. Biological Services Program, U.S. Fish and Wildlife Service. 340 pp.
- Fry, D. H. 1973. *Anadromous Fishes of California*. California Department of Fish and Game. 111 pp.
- Fryer, G. and T. D. Iles. 1972. *The Cichlid Fishes of the Great Lakes of Africa*. Hong Kong: TFH Publication. 610 pp.
- Gilbert, P. W. (ed.) 1963. *Sharks and Survival*. Boston, Massachusetts: D. C. Heath and Company. 578 pp.
- Goldstein, R. J. 1971. *Anabantoids: Gouramis and Related Fishes*. Neptune, New Jersey: TFH Publications. 169 pp.
- Günther, A. 1866. *Catalogue of the Fishes in the British Museum*. London: Taylor and Francis. Volume 6: 368 pp., Volume 7: 512 pp., Volume 8: 549 pp.
- Halkett, A. 1913. *Checklist of the Fishes of the Dominion of Canada and Newfoundland*. Ottawa, Canada: King's Printer. 138 pp.
- Hardisty, M. U., and I. C. Potter (eds.). 1971. *The Biology of Lampreys*, Volume 1. New York: Academic Press. 421 pp.
- Hardy, J. D., Jr. 1978. *Development of Fishes of the Mid-Atlantic Bight*. Volume 2. Biological Services Program, U. S. Fish and Wildlife Service. 458 pp.
- Hardy, J. D., Jr. 1978. *Development of Fishes of the Mid-Atlantic Bight*. Volume 3. Biological Services Program, U. S. Fish and Wildlife Service. 394 pp.
- Hart, J. L. 1973. *Pacific Fishes of Canada*. Fisheries Research Board of Canada Bulletin 180: 740 pp.
- Hermann, J. 1804. *Observationes Zoologicae*, quibus novae complures, aliaeque species describuntur et illustrantur: opus posthumum edidit Fr. L. Hammer. Argentorati., 4: 332 pp.
- Hildebrand, S. F., and W. C. Schroeder. 1928. *Fishes of the Chesapeake Bay*. Bulletin of the U. S. Bureau of Fisheries 53(1):388 pp.
- Hoffman, F. L. 1967. *Parasites of North American Freshwater Fishes*. Berkeley, California: University of California Press. 468 pp.
- Hubbs, C. L. and K. F. Lagler. 1964. *Fishes of the Great Lakes Region*. Ann Arbor, Michigan: University of Michigan Press. 213 pp.
- Jones, P. W., F. D. Martin, and J. D. Hardy, Jr. 1978. *Development of Fishes of the Mid-Atlantic Bight*. Volume 1. Biological Services Program, U. S. Fish and Wildlife Service. 366 pp.
- Jordan, D. S. 1878. *A Manual of the Vertebrates of the Northern United States*, including the district east of the Mississippi River, and North of North Carolina and Tennessee, exclusive of marine species, 2nd edition. Chicago, Illinois: Jansen, McClurg and Company. 407 pp.
- Jordan, D. S. 1929. *Manual of the Vertebrate Animals of Northeastern United States*, inclusive of marine species, 13th edition. Yonkers-on-Hudson, N.Y.: World Book Company. 446 pp.
- Katz, M. in Spector, W. S. (ed.). 1956. *Reproduction of Fish*. Data for Handbook of Biological Data. Philadelphia, Pennsylvania: W. B. Sanders. 584 pp.

- Lacepede, B. G. E. 1798. *Histoire Naturelle des Poissons*. Paris. Volume 2. 446 pp.
- Lindsey, C. C. and C. S. Woods (eds.). 1970. *Biology of Coregonid Fishes*. Winnipeg, Canada: University of Manitoba Press. 560 pp.
- Linnaeus, C. 1758. *Systema naturae*, per regnatria naturae secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Laurentii Salvii, Holmiae. (10th edition) Volume 1:824 pp.; (12th edition) Volume 1:532 pp.; (13th edition) Volume 1:1516 pp.
- Lowe-McConnell, R. H. 1975. *Fish Communities in Tropical Freshwaters*. New York: Longman, Inc. 337 pp.
- Mansueti, A. J. and J. D. Hardy, Jr. 1967. *Development of Fishes of the Chesapeake Bay Region*. Natural Resources Institute, University of Maryland. Baltimore, Maryland: Port City Press. 202 pp.
- McClane, A. J. (ed.) 1974. *McClane's New Standard Fishing Encyclopedia and International Angling Guide*. New York: Holt, Rinehart, and Winston. Volume 2. 1156 pp.
- McConnell, W. J., W. J. Clark, and W. F. Sigler. 1957. *Bear Lake, its fish and fishing*. Utah State Department of Fish and Game, Idaho Department of Fish and Game, and Utah State Agricultural College. 76 pp.
- Mitchill, S. L. 1814. Report in part of Samuel L. Mitchill, M.D., on the fishes of New York. New York: D. Carlisle. 28 pp.
- Morrow, J. E. 1974. *Illustrated Keys to the Fresh-water Fishes of Alaska*. Anchorage, Alaska: Alaska Northwest Publishing Company. 78 pp.
- Nelson, J. S. 1976. *Fishes of the World*. New York: John Wiley and Sons, Inc. 416 pp.
- Nichols, J. T. 1943. *The Freshwater Fishes of China*. New York: The American Museum of Natural History. 322 pp.
- Norman, J. R. 1934. *A Systematic Monograph of the Flatfishes (Heterostomata)*. Volume 1. Psettodidae, Bothidae, Pleuronectidae. London: British Museum (Natural History). 459 pp.
- Okada, Y. 1959-60. *Studies on the Freshwater Fishes of Japan*. Prefectural University of Mie Tsu, Mie Prefecture, Japan. 860 pp.
- Pallas, P. S. 1776. *Reise durch verschiedene Provinzen des russischen Reichs* (1768-74). St. Petersburg. Volume 3.
- Patterson, C. in Greenwood, P. H., R. S. Miles, and C. Patterson (eds.). 1973. Holosteans, pp. 233-305, in *Interrelationships of Fishes*. Supplement Number 1 to Zoological Journal of the Linnean Society. Volume 53. 536 pp.
- Pennant, T. 1784. *Arctic Zoology*. London: Henry Hughes. Volume 1. 185 pp.
- Rafinesque, C. S. 1820. *Ichthyologia Ohiensis*, or natural history of the fishes inhabiting the river Ohio and its tributary streams, preceded by a physical description of the Ohio and its branches. Lexington, Kentucky. 90 pp.
- Rees, A. 1810-24. *The cyclopaedia*, or Universal dictionary of arts, sciences, and literature.
- Regan, C. T. 1906. Pisces in Godman, F. D., and O. Salvin. 1906. *Biologia centrali-Americana*. Part 193. London. 32 pp.
- Richardson, J. 1836. *Fauna Borcali-Americana*, or the zoology of the northern parts of British America, containing descriptions of the objects of natural history collected on the late northern land expeditions, under the command of Sir John Franklin, R.N. London and Norwich. Volume 3. the Fish.
- Robbins, W. H. and H. R. MacCrimmon. 1974. *The Black Bass in America and Overseas*. Ste. Marie, Ontario: Biomanagement and Research Enterprises. 196 pp.

- Ruppell, W. P. E. S. 1852. *Verzeichniss der in dem Museum der Senckenbergischen Naturforschenden Gesellschaft Aufgestellten sammlungen. Vierte Abteilung: Fische und deren Skellette*. Frankfurt, Germany: 1-40.
- Schwartz, F. J. and G. H. Burgess. 1975. *Sharks of North Carolina and Adjacent Waters*. N.C. Department of Natural and Economic Resources, Division of Marine Fisheries, Information Series. 57 pp.
- Scott, W. B. 1967. *Freshwater Fishes of Eastern Canada*. Toronto, Canada: University of Toronto Press. 2nd edition. 137 pp.
- Siebold, P. F. von 1833-50. *Fauna Japonica, sive descriptio animalium quae in itinere per Japoniam suscepto annis 1823-30 collegit, notis, observationibus et adumbrationibus illustravit P.F. de Siebold*. 6 Volumes. Pisces 1846. Lugduni Batavorum. 323 pp.
- Spix, J. B. von and L. Agassiz. 1831. *Selecta genera et species piscium quos in itinere per Brasiliam annis 1817-1820...* 138 pp.
- Stevenson, H. M. 1976. *Vertebrates of Florida*. Gainesville, Florida: University Presses of Florida. 607 pp.
- Thomson, D. A., L. T. Findley, and A. N. Kerstitch. 1979. *Reef Fishes of the Sea of Cortez*. New York: John Wiley and Sons. 302 pp. (Cited in account as *Reef Fishes of the Gulf of California*).
- Viktorovsky, 1978. *Mechanisms of Speciation in Charr of Lake Kronotsky*.
- Vladykov, V. D. and J. R. Greeley. 1963. Order Acipenseridae, pp. 24-60 in *Fishes of the Western North Atlantic*. Memoir Sears Foundation for Marine Research. Number 1 (Part 3), Yale University.
- Wang, J. C. S. and R. J. Kernehan. 1979. *Fishes of the Delaware Estuaries*. Towson, Maryland: Ecological Associates Communications. 410 pp.
- Wheeler, A. C. 1969. *The Fishes of the British Isles and Northwest Europe*. East Lansing, Michigan: Michigan State University Press. 613 pp.
- Wiley, E. O., in Fisher (ed.) 1978. FAO species identification sheet, Fishing Area 31, West Central Atlantic, Lepisosteidae.
- Wootton, R. J. 1976. *The Biology of Sticklebacks*. N. Y.: Academic Press. 387 pp.

REGIONAL PUBLICATIONS

ALABAMA

- Ramsey, J. R. 1976. Freshwater Fishes. pp. 53-65 *in* Boschung, H. T. (ed.). Endangered and Threatened Plants and Animals of Alabama. Bulletin of the Alabama Museum of Natural History Number 2. 93 pp.
- Smith-Vaniz, W. F. 1968. *Freshwater Fishes of Alabama*. Auburn University, Auburn, Alabama: Agricultural Experiment Station. 211 pp.

ALASKA

- McPhail, J. D., and C. C. Lindsey. 1970. *Freshwater Fishes of Northwestern Canada and Alaska*. Fisheries Research Board of Canada Bulletin 173. 381 pp.
- Morrow, J. E. 1974. *Illustrated Keys to the Freshwater Fishes of Alaska*. Anchorage, Alaska: Alaska Northwest Publishing Company. 78 pp.
- Morrow, J. E. 1980. *The Freshwater Fishes of Alaska*. Anchorage, Alaska: Alaska Northwest Publishing Company. 300 pp.
- Quast, J. L., and E. L. Hall. 1972. List of fishes of Alaska and adjacent waters with a guide to some of their literature. NOAA Technical Report, National Marine Fisheries Service SSRF-658:1-47.
- Wilimovsky, N. J. 1954. Checklist of the fishes of Alaska. Stanford Ichthyological Bulletin 4(5):279-94.

ARIZONA

- Minckley, W. L. 1973. *Fishes of Arizona*. Phoenix, Arizona: W. L. Minckley and Arizona Game and Fish Department. 293 pp.

ARKANSAS

- Buchanan, T. M. 1973. *Key to the Fishes of Arkansas*. Little Rock, Arkansas: Arkansas Game and Fish Commission. 68 pp., 198 maps.
- Buchanan, T. M. 1974. Threatened Native Fishes of Arkansas. pp. 67-92 *in* Arkansas Natural Area Plan. Little Rock, Arkansas: Arkansas Department of Planning. 248 pp.

CALIFORNIA

- Hubbs, C. L., W. I. Follett, and L. J. Dempster. 1979. List of the fishes of California. Occasional Papers of the California Academy of Sciences Number 133. 51 pp.
- Moyle, P. B. 1976. *Inland Fishes of California*. Berkeley, California: University of California Press. 405 pp.

COLORADO

- Beckman, W. C. 1953. *Guide to the Fishes of Colorado*. University of Colorado Museum Leaflet 11. 110 pp.
- Everhart, W. H., and W. R. Seaman. 1971. *Fishes of Colorado*. Denver, Colorado: Colorado Game, Fish and Parks Division. 77 pp.

CONNECTICUT

- Donhan, J. J., and R. J. Craig. 1976. Rare and endangered species of Connecticut and their habitats. Connecticut State Geological and Natural History Survey, Report of Investigation 6. 137 pp.
- Whitworth, W. R., P. L. Berrien, and W. T. Keller. 1968. *Freshwater Fishes of Connecticut*. State Geological and Natural History Survey of Connecticut, Bulletin 101. 134 pp.

DELAWARE

- Lee, D. S., A. Norden, C. R. Gilbert, and R. Franz. 1976. A list of the freshwater fishes of Maryland and Delaware. Chesapeake Science 17(3):205-211.
- Lee, D. S., S. P. Platania, C. R. Gilbert, R. Franz, and A. Norden. In press. A revised list of the freshwater fishes of Maryland and Delaware. Proceedings of the Southeastern Fishes Council.
- Wang, J. C. S. 1977. Checklist of freshwater fishes collected in the inland waters of Delaware in 1969 through 1971. pp. 28-33 *in* Transactions of the Delaware Fisheries Seminar, Ashland Nature Center, Delaware Nature Education Society, Hockessin, Delaware.

FLORIDA

- Briggs, J. C. 1958. A list of Florida fishes and their distribution. *Bulletin of the Florida State Museum* 1(8):223-318.
- Carr, A. F., and C. J. Goin. 1955. *Guide to the Reptiles, Amphibians, and Freshwater Fishes of Florida*. Gainesville, Florida:University of Florida Press. 341 pp.
- Gilbert, C. R. (ed.). 1979. Part 4. Fishes. pp. 1-58 in P.C.H. Pritchard (ed.). *Rare and Endangered Biota of Florida*. State of Florida Game and Freshwater Fish Commission, 4 parts, Gainesville, Florida:University Presses of Florida.
- Gilbert, C. R., G. H. Burgess, and R. W. Yerger. In preparation. *The Freshwater Fishes of Florida*.

GEORGIA

- Dahlberg, M. D. 1975. *Guide to Coastal Fishes of Georgia and Nearby States*. Athens, Georgia:University of Georgia Press. 186 pp.
- Dahlberg, M. D., and D. C. Scott. 1971. The freshwater fishes of Georgia. *Bulletin of the Georgia Academy of Science* 29:1-64.
- Odom, R. R., and L. Landers. 1978. Proceedings of the Rare and Endangered Wildlife Symposium. Georgia Department of Natural Resources Game and Fish Division Technical Bulletin WL 4.

IDAHO

- Simpson, J. C., and R. L. Wallace. 1978. *Fishes of Idaho*. Moscow, Idaho:The University of Idaho Press of Idaho. 237 pp.

ILLINOIS

- Forbes, S. A., and R. E. Richardson. 1908. *The Fishes of Illinois*. Illinois State Laboratory of Natural History. 357 pp., + separate atlas containing 102 maps.
- Forbes, S. A., and R. E. Richardson. 1920. *The Fishes of Illinois*. 2nd ed. Illinois Natural History Survey. 357 pp.
- Smith, P. W. 1979. *The Fishes of Illinois*. Illinois State Natural History Survey. Urbana, Illinois:University of Illinois Press. 314 pp.

INDIANA

- Gerking, S. D. 1945. The distribution of the fishes of Indiana. *Investigation of Indiana Lakes and Streams* 3:1-137.
- Gerking, S. D. 1955. Key to the fishes of Indiana. *Investigation of Indiana Lakes and Streams* 4:49-86.

IOWA

- Harlan, J. R., and E. B. Speaker. 1951. *Iowa Fish and Fishing*. State Conservation Commission, State of Idaho. 237 pp.

KANSAS

- Cross, F.B. 1967. *Handbook of Fishes of Kansas*. University of Kansas Museum of Natural History Miscellaneous Publication 45: 1-357.
- Cross, F.B., and J.T. Collins. 1975. *Fishes of Kansas*. University of Kansas Museum of Natural History, Public Education Series 3: 1-189.

KENTUCKY

- Burr, B. M. In press. A distribution checklist of the fishes of Kentucky. *Brimleyana* Number 3.
- Clay, W. M. 1975. *The Fishes of Kentucky*. Frankfort, Kentucky:Kentucky Department of Fish and Wildlife Resources. 416 pp.

LOUISIANA

- Douglas, N. H. 1974. *Freshwater Fishes of Louisiana*. Baton Rouge, Louisiana:Claitors Publishing Division. 443 pp.

MAINE

- Everhart, W. H. 1966. *Fishes of Maine*. 3rd ed. Augusta, Maine:Maine Department of Inland Fisheries and Game. 96 pp.
- Kendall, W. C. 1914. An annotated catalogue of the fishes of Maine. Proceedings of the Portland Society of Natural History 3(10):1-198.

MARYLAND

- Lee, D. S., A. Norden, C. R. Gilbert, and R. Franz. 1976. A list of the freshwater fishes of Maryland and Delaware. Chesapeake Science 17(3):205-211.
- Lee, D. S., S. P. Platania, C. R. Gilbert, R. Franz, and A. Norden. In press. A revised list of the freshwater fishes of Maryland and Delaware. Proceedings of the Southeastern Fishes Council.

MASSACHUSETTS

- Mugford, P. S. 1969. Illustrated Manual of Massachusetts Freshwater Fish. Boston, Massachusetts:Massachusetts Division of Fish and Game. 127 pp.

MICHIGAN

- Hubbs, C. L., and G. P. Cooper. 1936. Minnows of Michigan. Bulletin Cranbrook Institute Science 8:1-99.
- Hubbs, C. L., and K. F. Lagler. 1946. *Fishes of the Great Lakes Region*. Bloomfield Hills, Michigan:Cranbrook Institute of Science. 186 pp.
- Taylor, W. R. 1954. Records of fishes in the John N. Lowe collection from the Upper Peninsula of Michigan. Miscellaneous Publications of the Museum of Zoology, University of Michigan 87:5-49.

MINNESOTA

- Eddy, S., and J. C. Underhill. 1974. *Northern fishes, with Special Reference to the Upper Mississippi Valley*. Minneapolis, Minnesota:University of Minnesota Press. 414 pp.
- Phillips, G. L., and J. C. Underhill. 1971. Distribution and variation of the Catostomidae of Minnesota. Occasional Papers Bell Museum of Natural History 10:1-45.
- Underhill, J. C. 1957. The distribution of Minnesota minnows and darters in relation to Pleistocene glaciation. Occasional Papers of the Minnesota Museum of Natural History 7:1-45.

MISSISSIPPI

- Clemmer, G. H., R. D. Suttkus, and J. S. Ramsey. 1975. A preliminary checklist of endangered and rare fishes of Mississippi. pp. 6-11 *in* Preliminary list of rare and threatened vertebrates in Mississippi. Mississippi Game and Fish Commission.
- Cook, F. A. 1959. *Freshwater Fishes in Mississippi*. Jackson, Mississippi:Mississippi Game and Fish Commission. 239 pp.

MISSOURI

- Pflieger, W. L. 1971. A distributional study of Missouri Fishes. University of Kansas Museum of Natural History, Publication 20(3):225-570.
- Pflieger, W. L. 1975. *The Fishes of Missouri*. Columbia, Missouri:Missouri Department of Conservation. 343 pp.

MONTANA

- Brown, C. J. D. 1971. *Fishes of Montana*. Bozeman, Montana:Montana State University. 207 pp.

NEBRASKA

- Johnson, R. E. 1941. The distribution of Nebraska fishes. Ph.D. dissertation. University of Michigan Library.
- Morris, J., L. Morris, and L. Witt. 1972. *The Fishes of Nebraska*. Lincoln, Nebraska:Nebraska Game and Parks Commission. 98 pp.

NEVADA

LaRivers, I. 1962. *Fish and Fisheries of Nevada*. Carson City, Nevada:Nevada State Fish and Game Commission. 782 pp.

NEW HAMPSHIRE

Bailey, R. M. 1938. Key to the freshwater fishes of New Hampshire. *in* The fishes of the Merrimack Watershed, Biological Survey of Merrimack Watershed, New Hampshire Fish and Game Department Biological Survey Report 3:149-185.

Scarola, J. F. 1973. *Freshwater Fishes of New Hampshire*. Concord, New Hampshire:New Hampshire Fish and Game Department. 131 pp.

NEW JERSEY

Stiles, E. W. 1978. *Vertebrates of New Jersey*. Somerset, New Jersey:Edmund W. Stiles, Publishers. 148 pp.

NEW MEXICO

Koster, W. J. 1957. *Guide to the Fishes of New Mexico*. Albuquerque, New Mexico:University of New Mexico Press. 116 pp.

NEW YORK

Greeley, J. R. 1927 to 1940. Watershed survey reports on fishes of New York rivers, published as supplements to the 16th through 29th Annual Reports of the New York State Conservation Department, Albany, New York.

Smith, C. L. In preparation. *Inland Fishes of New York*.

NORTH CAROLINA

Bailey, J. R. 1977. Freshwater Fishes. pp. 265-98 *in* Cooper, J. E., S. S. Robinson, and J. B. Funderburg (eds.). 1977. *Endangered and Threatened Plants and Animals of North Carolina*. Raleigh, NC:N.C. State Museum of Natural History. 444 pp.

Menhinick, E. F., T. M. Burton, and J. R. Bailey. 1974. An annotated checklist of the freshwater fishes of North Carolina. *Journal of the Elisha Mitchell Scientific Society* 90(1):24-50.

Menhinick, E. F. In preparation. *The Freshwater Fishes of North Carolina*.

Smith, H. M. 1907. *The Fishes of North Carolina*. North Carolina Geological and Economic Survey, Volume 2. 453 pp.

NORTH DAKOTA

Hankinson, T. L. 1929. Fishes of North Dakota. *Papers of the Michigan Academy of Science, Arts, and Letters* 10:439-460.

OHIO

Trautman, M. B. 1957. *The Fishes of Ohio*. Columbus, Ohio:Ohio State University Press. 683 pp.

OKLAHOMA

Miller, R. J., and H. W. Robison. 1973. *The Fishes of Oklahoma*. Stillwater, Oklahoma:Oklahoma State University Press. 246 pp.

OREGON

Bond, C. E. 1973. Keys to Oregon freshwater fishes. Corvallis, Oregon:Oregon State University Agricultural Experimental Station Technical Bulletin 58:1-42.

PENNSYLVANIA

Cooper, E. L. In preparation. *Fishes of Pennsylvania*.

Fowler, H. W. 1940. A list of the fishes recorded from Pennsylvania. *Bulletin of the Pennsylvania Board of Fish Commission* 7:1-25.

SOUTH CAROLINA

- Anderson, W. D. 1964. Fishes of some South Carolina coastal plain streams. *Quarterly Journal of the Florida Academy of Science* 27:31-54.
- Loyacano, H. A. 1975. *A list of freshwater fishes of South Carolina*. South Carolina Agricultural Experiment Station Bulletin 580:no pagination.

SOUTH DAKOTA

- Bailey, R. M., and M. O. Allum. 1962. Fishes of South Dakota. Miscellaneous Publications of the Museum of Zoology, University of Michigan Number 119. 131 pp.

TENNESSEE

- Etnier, D. A., and W. C. Starnes. In preparation. *The Fishes of Tennessee*.
- Kuhne, E. R. 1939. *A Guide to the Fishes of Tennessee and the mid-South*. Nashville, Tennessee:Tennessee Department of Conservation. 124 pp.

TEXAS

- Hubbs, C. 1972. A checklist of Texas freshwater fishes. *Texas Parks and Wildlife Department Technical Service* 11:1-11.
- Knapp, F. T. 1953. *Fishes Found in the Fresh Waters of Texas*. Brunswick, Georgia:Ragland Studio and Lithograph Printing Company. 166 pp.

UTAH

- Sigler, W. F., and R. R. Miller. 1963. *Fish of Utah*. Salt Lake City, Utah:Utah Game and Fish Department 203 pp.

VERMONT

- MacMartin, J. M. 1962. Vermont stream survey 1952-1960. Montpelier, Vermont:Vermont Fish and Game Department. 107 pp.

VIRGINIA

- Jenkins, R. E., N. M. Burkhead, and D. J. Jenkins. In preparation. *The Freshwater Fishes of Virginia*.

WASHINGTON

- Schultz, L. P. 1948. Key to the fishes of Washington, Oregon, and closely adjoining regions. *University of Washington Publication Biology* 2(4):103-228.
- Wydoski, R. S., and R. R. Whitney. 1979. *Inland Fishes of Washington*. University of Washington Press. 220 pp.

WEST VIRGINIA

- Denoncourt, R. F., E. C. Raney, C. H. Hocutt, and J. R. Stauffer, Jr. 1975. A checklist of the fishes of West Virginia. *Virginia Journal Science* 26(3):117-120.
- Hocutt, C. H., R. F. Denoncourt, and J. R. Stauffer, Jr. 1979. Fishes of the Gauley River, West Virginia. *Brimleyana* 1:47-80.

WISCONSIN

- Greene, C. W. 1935. *The Distribution of Wisconsin Fishes*. Wisconsin Conservation Commission. 235 pp., 96 maps.
- Johnson, M., and G. C. Becker. 1970. Annotated list of the fishes of Wisconsin. *Wisconsin Academy of Science Arts and Letters* 58:265-300.

WYOMING

- Baxter, G. T., and J. R. Simon. 1970. *Wyoming Fishes*. Cheyenne, Wyoming:Wyoming Game and Fish Department Bulletin 4. 168 pp.
- Simon, J. R. 1946. *Wyoming Fishes*. Wyoming Game and Fish Department Bulletin 4. 129 pp.
- Simon, J. R., and F. Simon. 1939. Checklist and keys of the fishes of Wyoming. University of Wyoming Publication 6(4):47-62.

CANADA

- Halkett, A. 1913. *Checklist of the fishes of the Dominion of Canada and Newfoundland*. Ottawa:King's Printer. 138 pp.
- McAllister, D. E., C. G. Gruchy, and B. Parker. In preparation. Rare and endangered fishes of Canada.
- McPhail, J. D. and C. C. Lindsey. 1970. *Freshwater Fishes of Northwestern Canada and Alaska*. Fisheries Research Board of Canada Bulletin 173. 381 pp.
- Scott, W. B., and E. J. Crossman. 1973. *Freshwater Fishes of Canada*. Fisheries Research Board of Canada Bulletin 184. 866 pp.
- Walters, V. 1955. Fishes of western Arctic America and Alaska. Bulletin of the American Museum of Natural History 106:259-368.

EASTERN CANADA

- Hubbs, C. L., and K. F. Lagler. 1964. *Fishes of the Great Lakes region*. Ann Arbor, Michigan:University of Michigan Press. 213 pp.
- McAllister, D. E., and B. W. Coad. 1974. *Fishes of Canada's National Capital Region*. Fisheries and Marine Service, Miscellaneous Special Publication 24. 200 pp.

EAST COAST OF CANADA

- Leim, A. H., and W. B. Scott. 1966. *Fishes of the Atlantic Coast of Canada*. Fisheries Research Board of Canada Bulletin 155. 485 pp.

ALBERTA

- Paetz, M. J., and J. S. Nelson. 1970. *The Fishes of Alberta*. Edmonton:Queen's Printer. 282 pp.

BRITISH COLUMBIA

- Carl, G. C., W. A. Clemens, and C. C. Lindsey. 1967. *The Freshwater Fishes of British Columbia*. 4th ed. British Columbia Provincial Museum Handbook 5. 192 pp.
- Hart, J. L. 1973. *Pacific Fishes*. 2nd ed. Fisheries Research Board of Canada Bulletin 180. 740 pp.

MANITOBA

- Fedoruk, A. N. 1969. Checklist and key of the freshwater fishes of Manitoba. Manitoba Department of Mines and Natural Resources, Canada Land Inventory Project:1-98.
- Hinks, D. 1943. *The Fishes of Manitoba*. Manitoba Department of Mines and Natural Resources. 102 pp.

NEW BRUNSWICK

- Gorham, S. W. 1970. *Distributional checklist of the fishes of New Brunswick*. Saint John, New Brunswick. 32 pp.
- Scott, W. B., and E. J. Crossman. 1959. The freshwater fishes of New Brunswick. A checklist with distributional notes. Royal Ontario Museum, Division of Zoology and Palaeontology, Contribution 51:1-37.

NORTHWEST TERRITORIES

- Stein, J. N., C. S. Jessop, T. R. Porter, and K. T. J. Chang-Kue. 1973. An evaluation of the fish resources of the McKenzie River Valley as related to pipeline development. Volume 1. Environmental-Social committee Northern Pipelines, Task Force on Northern Development Report 73-1. Information Canada Catalogue Number Fs37-1973/1-1. 122 pp.

NOVA SCOTIA

- Gilhen, J. 1974. *The Fishes of Nova Scotia's Lakes and Streams*. Nova Scotia Museum, Halifax. 49 pp.
- Livingstone, D. A. 1951. The freshwater fishes of Nova Scotia. *Nova Scotian Institute of Science Proceedings* 23:1-90.

ONTARIO

- MacKay, H. H. 1963. *Fishes of Ontario*. Ontario Department of Lands and Forest. 360 pp.
- Ryder, R. A., W. B. Scott, and E. J. Crossman. 1964. Fishes of northern Ontario, north of the Albany River. *Royal Ontario Museum, Life Sciences Contribution* 60:1-30.

QUEBEC

- Legendre, V. 1954. *Key to Game and Commercial Fishes of the Province of Quebec*. 1st English ed. Quebec Department of Game and Fisheries. 189 pp.
- Masse G., et J. Mongeau. 1974. *Repartition geographique des poissons, leur abondance relative et bathymetrie de la region du Lac Saint-Pierre*. Service de l'Amenagement de la Faune, Ministere du Tourisme, de la Chasse et de la Peche, Quebec. 59 pp.
- Melancon, C. 1958. *Les poissons de nos eaux*. 3rd ed. Quebec:La Societe zoologique de Quebec. 254 pp.
- Mongeau J., A. Courtemanche, G. Masse, et Bernard Vincent. 1974. *Cartes de repartition geographique des especes de poissons au sud du Quebec, d'apres les inventaires ichthyologiques effectues de 1963 a 1972*. Faune du Quebec, Rapport Special 4.92 pp.
- Mongeau J., et G. Masse. 1976. *Les poissons de la region de Montreal, la peche sportive et commerciale, les ensemencements, les frayeres, la contamination par le mercure et les PCB*. Service de l'Amenagement de la Faune, Ministere du Tourisme, de la Chasse et de la Peche, Quebec. 286 pp.

SASKATCHEWAN

- Symington, D. F. 1959. The Fish of Saskatchewan. Saskatchewan Department of Natural Resources, Conservation Bulletin 7 :1-25.

YUKON TERRITORY

- Bryan, J. E. 1973. The influence of pipeline development on freshwater fishery resources of northern Yukon Territory. Aspects of research conducted in 1971 and 1972. Environmental-Social Committee Northern Pipelines, Task Force on Northern Development Report Number 73-6, Information Canada Catalogue Number R72-9773. 63 pp.

GENERAL

- Crossman, E. J. and H. D. VanMeter 1979. Annotated List of the Fishes of the Lake Ontario watershed. Technical Report 36 Great Lakes Fishery Commission. Ann Arbor, Michigan.
- Eddy, S. and T. Surber 1947. *Northern Fishes with Special Reference to the Upper Mississippi Valley*. Minneapolis, Minnesota: University of Minnesota Press. 2nd edition. 267 pp.
- Hubbs, C. L. and K. F. Lagler. 1947. *Fishes of the Great Lakes Region*. Bloomfield Hills, Michigan: The Cranbrook Press. 186 pp.
- Jenkins, R. E., E. A. Lachner, and F. J. Schwartz. 1972. Fishes of the central Appalachian drainages: Their distribution and dispersal. pp. 43-117. P. C. Holt (ed.). The distributional history of the biota of the Southern Appalachians. Part III: Vertebrates. Research Division Monograph 4. Blacksburg, Virginia: Virginia Polytechnic Institute and State University.
- Metcalf, A. L. 1966. Fishes of the Kansas River System in relation to zoogeography of the Great Plains. University of Kansas, Publication of the Museum of Natural History. 17(3):23-189.
- Miller, R. R. 1948. The cyprinodont fishes of the Death Valley System of Eastern California and southwestern Nevada. Miscellaneous Publication of the Museum of Zoology of the University of Michigan. 68:1-55.
- Miller, R. R. 1959. Origin and affinities of the freshwater fish fauna of western North America. *in* C. L. Hubbs (ed.), Zoogeography Publication Number 51. Washington, DC: American Association for the Advancement of Science.

- Rostlund, E. 1952. Freshwater fish and fishing in native North America. University of California Geography Publications 9:1-313.
- Seehorn, M. E. 1975. Fishes of Southeastern National Forests. Proceedings 29th Annual Conference Southeastern Association Game Fish Commissions: 10-27.
- Soltz, D. L. and R. J. Naiman. 1978. *The Natural History of Native Fishes in the Death Valley System*. Natural History Museum of Los Angeles County. Science Series 30:1-76.

APPENDIX B COMPILERS

Alice W. Allen-Grimes
NSCM of Natural History
P.O. Box 27647
Raleigh, NC 27611

Teri Y. Barila
Appalachian Environmental Laboratory
University of Maryland
Frostburg State College Campus
Frostburg, MD 21532

Bruce H. Bauer
Department of Zoology
The University of Tennessee
Knoxville, TN 37916

Eugene C. Beckham, III
Museum of Zoology
Louisiana State University
Baton Rouge, LA 70893

Robert J. Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523

William S. Birkhead
Director of Science and Mathematics
Columbus College
Columbus, GA 31907

James E. Böhlke
Academy of Natural Sciences
Nineteenth and Parkway
Philadelphia, PA 19103

Carl E. Bond
Department of Fisheries and Wildlife
Oregon State University
Corvallis, OR 97331

Herbert T. Boschung
Department of Biology
P.O. Box 1927
The University of Alabama
University, AL 35486

Roberte Boyle
Department of Biology
University of Ottawa
Ottawa, ON
Canada K1N 6N5

Richard J. Bragg
The University of Nebraska at Omaha
Box 688
Omaha, NB 68101

John C. Bruner
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, IL 60605

George H. Burgess
The Florida State Museum
University of Florida
Gainesville, FL 32611

Noel M. Burkhead
Department of Biology
Roanoke College
Salem, VA 24153

Brooks M. Burr
Department of Zoology
Southern Illinois University
at Carbondale
Carbondale, IL 62901

Don G. Buth
Department of Biology
University of California, Los Angeles
Los Angeles, CA 90024

David A. Cannemela
Department of Biological Sciences
College of Environmental Sciences
Murray State University
Murray, KY 422071

Robert C. Cashner
Department of Biological Sciences
University of New Orleans
Lake Front
New Orleans, LA 70122

Ted M. Cavender
Museum of Zoology
1813 N. High Street
The Ohio State University
Columbus, OH 43210

R. McV. Clarke
Biological Advisor
Freshwater Institute
501 University Crescent
Winnipeg, MB
Canada R3T 2N6

Glenn H. Clemmer
Department of Biological Sciences
P.O. Drawer G.Y.
Mississippi State, MS 39761

Don G. Cloutman
Duke Power Company
Steam Production Department
Environmental Laboratories
Route 4, Box 531
Huntersville, NC 28078

John E. Cooper
NCSM of Natural History
P.O. Box 27647
Raleigh, NC 27611

Walter R. Courtenay
Department of Biological Sciences
Florida Atlantic University
Boca Raton, FL 33432

K. E. Couvillion
National Museum of Canada
Ottawa, ON
Canada K1A 0M8

Edward J. Crossman
Curator of Ichthyology and Herpetology
Royal Ontario Museum
100 Queen's Park
Toronto, ON
Canada M5S 2C6

Robert F. Denoncourt
Country Club Road
York College of Pennsylvania
York, PA 17405

Neil H. Douglas
Professor of Biology
Director and Curator
Museum of Zoology
Northeast Louisiana University
Monroe, LA 71209

Charles F. Duggins
Department of Biological Sciences
The Florida State University
Tallahassee, FL 32306

Daphne Ebaugh
Department of Biology
Roanoke College
Salem, VA 24153

Edward Esmond
Appalachian Environmental Laboratory
University of Maryland
Frostburg State College Campus
Frostburg, MD 21532

David A. Etnier
Department of Zoology
The University of Tennessee
Knoxville, TN 37916

Richard Franz
The Florida State Museum
University of Florida
Gainesville, FL 37611

Calvin R. Fremling
Professor of Biology
Winona State University
Winona, MN 55987

Kevin W. Gasser
Department of Fisheries and Wildlife
Oregon State University
Corvallis, OR 97331

Charles D. Getter
School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149

Carter R. Gilbert
The Florida State Museum
University of Florida
Gainesville, FL 32611

Ron J. Gilbert
Georgia Cooperative Fisheries
Research Unit
School of Forest Resources
University of Georgia
Athens, GA 30602

J. Gilhen
Nova Scotia Museum
1747 Summer Street
Halifax, NS
Canada

Garrett S. Glodek
College of Fisheries WH-10
University of Washington
Seattle, WA 98195

Chuck G. Gruchy
National Museum of Canada
Ottawa, ON
Canada K1A 0M8

Vincent Guillory
Louisiana Department of Wildlife and
Fisheries
Grande Terre Marine Laboratory
P.O. Box 37
Grande Isle, LA 70357

J. David Hardy
22 Wade Avenue
Catonsville, MD 21228

Herschel L. Harrell
12140 East 36th Place
Tulsa, OK 74145

John L. Harris
Department of Zoology
The University of Tennessee
Knoxville, TN 37916

Philip A. Hastings
Harbor Branch Foundation, Inc.
Link Port, RRI, Box 196
Fort Pierce, FL 33450

Dannie A. Hensley
Department of Marine Science
University of Puerto Rico
Mayaguez, Puerto Rico 00708

Michael L. Hendricks
Appalachian Environmental Laboratory
University of Maryland
Frostburg State College Campus
Frostburg, MD 21532

Charles H. Hocutt
Appalachian Environmental Laboratory
University of Maryland
Frostburg State College Campus
Frostburg, MD 21532

Paul B. Holden
Bio West, Inc.
P.O. Box 3226
Logan, UT 84321

Kevin M. Howe
Department of Fisheries and Wildlife
Oregon State University
Corvallis, OR 97331

William M. Howell
Department of Biology
Samford University
Birmingham, AL 35209

Robert E. Jenkins
Department of Biology
Roanoke College
Salem, VA 24153

William E. Johnson
Florida Game and Freshwater
Fish Commission
P.O. Box 1903
Eustis, FL 32726

Edward Kott
Wildrid Laurier University
Waterloo, ON
Canada K2L 3C5

Stephen T. Kucas
4623A Fillmore Drive
Wilmington, NC 28403

Ernest A. Lachner
Fish Division
U.S. National Museum
Washington, DC 20560

Philip H. Lahrmann
Department of Biology
Roanoke College
Salem, VA 24153

Jacqueline Lanteigne-Courchene
Department of Biology
Faculty of Science and Engineering
University of Ottawa
Ottawa, ON
Canada K1N 6N5

David S. Lee
NCSM of Natural History
P.O. Box 27647
Raleigh, NC 27611

David G. Lindquist
Biology Department
University of North Carolina
at Wilmington
Wilmington, NC 28403

James J. Long
Department of Fisheries and Wildlife
Oregon State University
Corvallis, OR 97331

Glenn Longley
Aquatic Station
Southwest Texas State University
San Marcos, TX 78666

Robert W. Malick, Jr.
Ichthyological Associates, Inc.
P.O. Box 223
Etters, PA 17319

Anne Marchand
283 Pharmacy Avenue
Apt. 1615
Scarborough, ON
Canada M1L 3G1

Barbara Martin
National Museum of Natural Sciences
Ottawa, ON
Canada K1A 0M8

F. Doug Martin
University of Maryland
Chesapeake Biological Laboratory
Solomons, MD 20688

Michael T. Masnick
Environmental Specialist Branch
U. S. Nuclear Regulatory Commission
Washington, DC 20545

R. Edward Matheson
Department of Wildlife and Fisheries
Science
Texas A & M University
College Station, TX 77843

William J. Matthews
The University of Oklahoma
Biological Station
Star Route B
Kingston, OK 73439

Richard L. Mayden
Southern Illinois University
at Carbondale
Carbondale, IL 62901

Don E. McAllister
Curator of Fishes
National Museum of Canada
Ottawa, ON
Canada K1A 0M8

Bernard A. Megrey
Institute of Environmental Sciences
Miami University
Oxford, OH 45056

John W. Meldrim
Ichthyological Associates
100 South Cass Street
Middletown, DE 19709

William L. Minckley
Department of Zoology
Arizona State University
Tempe, AZ 85281

James E. Morrow, Jr.
Professor of Zoology, Emeritus
P.O. Box 605
Port Oxford, OR 97465

Peter B. Moyle
Wildlife and Fisheries Biology
University of California
Davis, CA 95616

Robert W. Murphy
Department of Biology
University of California, Los Angeles
Los Angeles, CA 90024

Arnold Norden
Rummel, Klepper, and Kahl
1035 N. Calvert Street
Baltimore, MD 21202

Larry M. Page
Illinois Natural History Survey
172 Natural Resources Bldg.
Urbana, IL 61801

Brad J. Parker
Beak Consultants Ltd.
6870 Goreway Drive
Mississauga, ON
Canada L4V 1L9

William L. Pflieger
Fisheries Research
Missouri Department of Conservation
1110 College Avenue
Columbia, MO 65201

Steven P. Platania
NCSM of Natural History
P.O. Box 27647
Raleigh, NC 27611

Walter A. Pursley
NCSM of Natural History
P.O. Box 27647
Raleigh, NC 27611

John S. Ramsey
Cooperative Fishery Unit
Auburn University
Auburn, AL 36830

Mike Rankin
National Museum of Canada
Ottawa, ON
Canada K1A 0M8

Claude Renaud
Department of Biology
University of Ottawa
Ottawa, ON
Canada K1N 6N5

John N. Rinne
Rocky Mountain Forest and Range
Experiment Station
Forestry Sciences Laboratory
Arizona State University
Tempe, AZ 85281

William Rinne
U. S. Department of the Interior
Bureau of Reclamation
Yuma Projects Office
Bin 5569
Yuma, AZ 85364

Luis R. Rivas
5121 Southeast Fisheries Center
75 Virginia Beach Drive
Miami, FL 33149

Henry W. Robison
Southern Arkansas University
Magnolia Campus
Magnolia, AR 71753

Fred C. Rohde
Tallulah Falls School
Tallulah Falls, GA 30573

Steve W. Ross
Division of Marine Fisheries
Box 769
Morehead City, NC 28557

Charles F. Saylor
Division of Forestry
Fisheries and Wildlife Development
Tennessee Valley Authority
Norris, TN 37828

Charles G. Scalet
Wildlife and Fisheries Sciences
202 Agricultural Hall Annex
South Dakota State University
Brookings, SD 57006

W. B. Scott
Huntsman Marine Laboratory
Brandy Cove
St. Andrews, NB
Canada E0G 2X0

John R. Shute
Biology Department
University of North Carolina
at Wilmington
Wilmington, NC 28403

Peggy W. Shute
Biology Department
University of North Carolina
at Wilmington
Wilmington, NC 28403

Reinald E. Smith, Jr.
Appalachian Environmental Laboratory
University of Maryland
Frostburg State College Campus
Frostburg, MD 21532

Franklin F. Snelson, Jr.
Department of Biological Sciences
University of Central Florida
Box 25000
Orlando, FL 32816

Deborah S. Sorensen
160 Evergreen Road
Apt. 4-A
Edison, NJ 08817

Wayne C. Starnes
Department of Zoology
The University of Tennessee
Knoxville, TN 37916

Lynn B. Starnes
Division of Forestry
Fisheries and Wildlife Development
Tennessee Valley Authority
Norris, TN 37828

Richard H. Stasiak
The University of Nebraska at Omaha
Box 688
Omaha, NB 68101

Jay R. Stauffer, Jr.
Appalachian Environmental Laboratory
University of Maryland
Frostburg State College Campus
Frostburg, MD 21532

Michael M. Stevenson
Department of Biological Sciences
University of New Orleans
Lake Front
New Orleans, LA 70122

Richard E. Strauss
Department of Biology
208 Life Sciences
Pennsylvania State University
University Park, PA 16802

Camm C. Swift
Natural History Museum
Los Angeles County
900 Exposition Boulevard
Los Angeles, CA 90007

Stephen H. Taub
U. S. Fish and Wildlife Service (OEC)
Washington, DC 20240

Bruce A. Thompson
Center for Wetland Resources
Louisiana State University
Baton Rouge, LA 70803

Thomas J. Timmons
Department of Fisheries
and Allied Aquacultures
Auburn University
Auburn, AL 36830

Thomas N. Todd
Great Lakes Fishery Laboratory
1451 Green Road
Ann Arbor, MI 48105

Vadim D. Vladykov
Department of Biology
University of Ottawa
Ottawa, ON
Canada K1N 6N5

Ben R. Wall
Department of Biology
Walker College
Jasper, AL 35501

Richard K. Wallace
Department of Fisheries
and Allied Aquacultures
Auburn University
Auburn, AL 36830

Richard L. Wallace
Department of Biological Sciences
University of Idaho
Moscow, ID 83843

Alan W. Wells
Biological Sciences Centre
The University of Alberta
Edmonton, AT
Canada T6G 2E9

LaRue Wells
Great Lakes Fishery Laboratory
1451 Green Road
Ann Arbor, MI 48105

Edward O. Wiley, III
Museum of Natural History
University of Kansas
Lawrence, KS 66045

Jack E. Williams
Department of Fisheries and Wildlife
Oregon State University
Corvallis, OR 97331

Ralph W. Yerger
The Florida State University
Tallahassee, FL 32306

Timothy Zorach
Maine Audubon Society
Gilsland Farm
118 Old Route 1
Falmouth, ME 04105

INDEX TO COMMON AND SCIENTIFIC NAMES IN THE ATLAS OF NORTH AMERICAN FRESHWATER FISHES

Only current names used in headings of species accounts and family names in the Table of Contents are indexed. Synonyms, subgenera, subspecies and other taxa discussed only in the text are not indexed. Binomens are indexed uninverted as *Esoc lucius*, and not as *lucius*, *Esoc*. However, common names are indexed only in inverted fashion, e.g. pike, northern, and not as northern pike.

We thank Michele Steigerwald and Don E. McAllister (National Museums of Canada) for preparing this index.

A

Acantharchus pomotis, 577
Acanthogobius flavimanus, 785
 acara, black, 764
Acipenser brevirostrum, 38
Acipenser fulvescens, 39
Acipenser medirostris, 40
Acipenser oxyrhynchus, 41
Acipenser transmontanus, 42
 Acipenseridae, 38
Acrocheilus alutaceus, 140
Agonostomus monticola, 778
Agosia chrysogaster, 141
 alewife, 65
Alosa aestivalis, 61
Alosa alabamiae, 62
Alosa chrysochloris, 63
Alosa mediocris, 64
Alosa pseudoharengus, 65
Alosa sapidissima, 67
Ambloplites ariommus, 578
Ambloplites cavifrons, 579
Ambloplites constellatus, 580
Ambloplites rupestris, 581
 Amblyopsidae, 478
Amblyopsis rosae, 478
Amblyopsis spelaea, 479
Amia calva, 53
 Amiidae, 53
Ammocrypta asprella, 615
Ammocrypta beani, 616
Ammocrypta bifascia, 617
Ammocrypta clara, 618
Ammocrypta meridiana, 619
Ammocrypta pellucida, 620
Ammocrypta rivax, 621
Anchoa mitchilli, 73
 anchovies, 73
 anchovy, bay, 73
Anguilla rostrata, 59
 Anguillidae, 59
Apeltes quadracus, 561
 Aphredoderidae, 484
Aphredoderus sayanus, 484
Aplodinotus grunniens, 756
Archoplites interruptus, 582
Archosargus probatocephalus, 754
 Ariidae, 476
Arius felis, 476
Astronotus ocellatus, 763
Astyanax mexicanus, 139
 Atherinidae, 557
Atractosteus spatula, 47
Awaous tajasica, 786

B

Bairdiella chrysoura, 757
 bass, Guadalupe, 609
 bass, largemouth, 608
 bass, redeye, 604
 bass, Roanoke, 579
 bass, rock, 581
 bass, shadow, 578
 bass, smallmouth, 605
 bass, spotted, 607
 bass, striped, 576
 bass, Suwannee, 606
 bass, white, 574
 bass, yellow, 575
 basses, temperate, 573
Belonesox belizanus, 537
 Belonidae, 489
 Belontiidae, 799
 bitterling, 357
 blackfish, Alaska, 127
 blackfish, Sacramento, 329
 blindcat, toothless, 474
 blindcat, widemouth, 473
 bloater, 81
 bluegill, 597
 Bothidae, 828
 bowfin, 53
 bowfins, 53
 buffalo, bigmouth, 405
 buffalo, black, 406
 buffalo, smallmouth, 404
 bullhead, black, 441
 bullhead, brown, 443
 bullhead, flat, 444
 bullhead, snail, 437
 bullhead, spotted, 447
 bullhead, yellow, 442
 burbot, 487

C

Campostoma anomalum, 143
Campostoma oligolepis, 145
Campostoma ornatum, 146
 Carangidae, 749
Caranx hippos, 749
Carassius auratus, 147
 Carcharhinidae, 36
Carcharhinus leucas, 36
 carp, common, 152
 carp, grass, 151
Carpiodes carpio, 367
Carpiodes cyprinus, 368
Carpiodes velifer, 369
 carpsucker, highfin, 369
 carpsucker, river, 367

- catfish, blue, 439
- catfish, channel, 446
- catfish, flathead, 472
- catfish, hardhead, 476
- catfish, headwater, 440
- catfish, walking, 475
- catfish, white, 438
- catfish, Yaqui, 445
- catfishes, airbreathing, 475
- catfishes, armored, 477
- catfishes, bullhead, 437
- catfishes, sea, 476
- Catostomidae, 367
- Catostomus ardens*, 370
- Catostomus bernardini*, 371
- Catostomus catostomus*, 372
- Catostomus clarki*, 373
- Catostomus columbianus*, 374
- Catostomus commersoni*, 375
- Catostomus discobolus*, 377
- Catostomus fecundus*, 378
- Catostomus fumeiventris*, 379
- Catostomus insignis*, 380
- Catostomus latipinnis*, 381
- Catostomus luxatus*, 382
- Catostomus macrocheilus*, 383
- Catostomus microps*, 384
- Catostomus occidentalis*, 385
- Catostomus platyrhynchus*, 386
- Catostomus plebeius*, 387
- Catostomus rimiculus*, 388
- Catostomus santaanae*, 389
- Catostomus snyderi*, 390
- Catostomus tahoensis*, 391
- Catostomus warnerensis*, 392
- cavefish, Alabama, 482
- cavefish, northern, 479
- cavefish, Ozark, 478
- cavefish, southern, 483
- cavefish, spring, 480
- cavefishes, 478
- Centrarchidae, 577
- Centrarchus macropterus*, 583
- Centropomidae, 569
- Centropomus ensiferus*, 569
- Centropomus parallelus*, 570
- Centropomus pectinatus*, 571
- Centropomus undecimalis*, 572
- Chaetodipterus faber*, 762
- char, Angayukaksurak, 112
- char, Arctic, 111
- Characidae, 139
- characins, 139
- Chasmistes brevirostris*, 393
- Chasmistes cujus*, 394
- Chasmistes liorus*, 395
- chiselmouth, 140
- Chologaster agassizi*, 480
- Chologaster cornuta*, 481
- chub, Alvord, 159
- chub, arroyo, 169
- chub, bigeye, 181
- chub, bigmouth, 217
- chub, blotched, 188
- chub, blue, 162
- chub, bluehead, 213
- chub, bonytail, 167
- chub, bull, 218
- chub, Chihuahua, 168
- chub, clear, 195
- chub, creek, 361
- chub, flame, 173
- chub, flathead, 186
- chub, gravel, 196
- chub, highback, 187
- chub, hornyhead, 211
- chub, humpback, 165
- chub, lake, 150
- chub, least, 198
- chub, leatherside, 163
- chub, lined, 190
- chub, Oregon, 183
- chub, redeye, 270
- chub, redspot, 210
- chub, redtail, 212
- chub, Rio Grande, 170
- chub, river, 215
- chub, rosyface, 193
- chub, roundtail, 172
- chub, Sandhills, 363
- chub, Santee, 197
- chub, sicklefin, 191
- chub, silver, 194
- chub, slender, 182
- chub, sonora, 166
- chub, speckled, 180
- chub, spotfin, 192
- chub, streamline, 184
- chub, sturgeon, 185
- chub, thicklip, 189
- chub, thicktail, 164
- chub, tui, 161
- chub, Utah, 160
- chub, Yaqui, 171
- chubsucker, creek, 397
- chubsucker, lake, 399
- chubsucker, sharpfin, 400
- Cichlasoma bimaculatum*, 764
- Cichlasoma cyanoguttatum*, 765
- Cichlasoma meeki*, 766
- Cichlasoma nigrofasciatum*, 767
- Cichlasoma octofasciatum*, 768
- Cichlasoma severum*, 769
- cichlid, banded, 769
- cichlid, convict, 767
- Cichlidae, 763
- cichlids, 763
- cisco, 77
- cisco, Arctic, 78
- cisco, Bering, 84
- cisco, blackfin, 86
- cisco, Bonneville, 100
- cisco, deepwater, 82
- cisco, least, 90
- cisco, longjaw, 76
- cisco, Nipigon, 87
- cisco, shortjaw, 91
- cisco, shortnose, 89
- Citharichthys spilopterus*, 828
- Clarias batrachus*, 475
- Clariidae, 475
- Clevelandia ios*, 787
- Clinocottus acuticeps*, 800
- Clinostomus elongatus*, 148

Clinostomus funduloides, 149
 Clupeidae, 61
 Cobitidae, 436
 codfishes, 487
Coregonus alpenae, 76
Coregonus artedii, 77
Coregonus autumnalis, 78
Coregonus canadensis, 79
Coregonus clupeaformis, 80
Coregonus hoyi, 81
Coregonus johanna, 82
Coregonus kiyi, 83
Coregonus laurettae, 84
Coregonus nasus, 85
Coregonus nigripinnis, 86
Coregonus nipigon, 87
Coregonus pidschian, 88
Coregonus reighardi, 89
Coregonus sardinella, 90
Coregonus zenithicus, 91
 Cottidae, 800
Cottus aleuticus, 801
Cottus asper, 802
Cottus asperrimus, 803
Cottus baileyi, 804
Cottus bairdi, 805
Cottus beldingi, 806
Cottus carolinae, 807
Cottus cognatus, 808
Cottus confusus, 809
Cottus echinatus, 810
Cottus extensus, 811
Cottus girardi, 812
Cottus greenei, 813
Cottus gulosus, 814
Cottus klamathensis, 815
Cottus leiopomus, 816
Cottus marginatus, 817
Cottus perplexus, 818
Cottus pitensis, 819
Cottus princeps, 820
Cottus pygmaeus, 821
Cottus rhotheus, 822
Cottus ricei, 823
Cottus tenuis, 824
Couesius plumbeus, 150
 crappie, black, 613
 crappie, white, 611
Crenichthys baileyi, 491
Crenichthys neradae, 492
 croaker, Atlantic, 760
Ctenopharyngodon idella, 151
 cui-ui, 394
Culaea inconstans, 562
Cyaleptus elongatus, 396
Cymatogaster aggregata, 776
Cynoscion nebulosus, 758
 Cyprinidae, 140
Cyprinodon borinus, 493
Cyprinodon diabolis, 494
Cyprinodon elegans, 495
Cyprinodon eximius, 496
Cyprinodon macularius, 497
Cyprinodon nevadensis, 498
Cyprinodon pecosensis, 499
Cyprinodon radiosus, 500
Cyprinodon rubrofluvialis, 501
Cyprinodon salinus, 502
Cyprinodon tularosa, 503
Cyprinodon variegatus, 504
 Cyprinodontidae, 491
Cyprinus carpio, 152
 D
 dace, blacknose, 352
 dace, blackside, 335
 dace, desert, 155
 dace, finescale, 338
 dace, leopard, 355
 dace, longfin, 141
 dace, longnose, 353
 dace, Moapa, 207
 dace, mountain redbelly, 339
 dace, northern redbelly, 336
 dace, pearl, 364
 dace, redbelly, 148
 dace, relict, 351
 dace, rosieside, 149
 dace, southern redbelly, 337
 dace, speckled, 356
 dace, Umpqua, 354
Dallia pectoralis, 127
 darter, amber, 715
 darter, Arkansas, 639
 darter, Arkansas saddled, 645
 darter, arrow, 689
 darter, ashy, 635
 darter, backwater, 711
 darter, banded, 710
 darter, barcheck, 674
 darter, Bayou, 686
 darter, blackbanded, 730
 darter, blackside, 728
 darter, blackside snubnose, 642
 darter, blenny, 629
 darter, bluebreast, 632
 darter, blueside, 656
 darter, bluestripe, 723
 darter, bluntnose, 634
 darter, bronze, 734
 darter, brown, 643
 darter, Carolina, 637
 darter, channel, 721
 darter, cherry, 644
 darter, Choctawhatchee, 640
 darter, Christmas, 654
 darter, coldwater, 641
 darter, Coosa, 638
 darter, coppercheek, 623
 darter, creole, 636
 darter, crystal, 615
 darter, Cumberland snubnose, 625
 darter, cypress, 683
 darter, dirty, 676
 darter, dusky, 740
 darter, eastern sand, 620
 darter, fantail, 647
 darter, finescale saddled, 678
 darter, Florida sand, 617
 darter, fountain, 648
 darter, freckled, 725
 darter, gilt, 724
 darter, glassy, 708
 darter, goldline, 717
 darter, goldstripe, 680
 darter, greenbreast, 657

darter, greefin, 633
 darter, greenside, 628
 darter, greenthroat, 661
 darter, Gulf, 699
 darter, harlequin, 653
 darter, Iowa, 646
 darter, Johnny, 672
 darter, Kanawha, 659
 darter, least, 668
 darter, leopard, 735
 darter, lollypop, 670
 darter, longfin, 662
 darter, longhead, 726
 darter, longnose, 729
 darter, Maryland, 691
 darter, Missouri saddled, 701
 darter, mud, 624
 darter, naked sand, 616
 darter, Niangua, 671
 darter, Okaloosa, 675
 darter, olive, 742
 darter, orangebelly, 685
 darter, orangefin, 627
 darter, orangethroat, 695
 darter, paleback, 679
 darter, Piedmont, 722
 darter, pinewoods, 665
 darter, rainbow, 631
 darter, redband, 663
 darter, redfin, 709
 darter, redline, 687
 darter, Rio Grande, 652
 darter, river, 741
 darter, riverweed, 682
 darter, Roanoke, 739
 darter, rock, 688
 darter, Saluda, 690
 darter, Savannah, 649
 darter, sawcheek, 692
 darter, scaly sand, 621
 darter, seagreen, 702
 darter, sharphead, 622
 darter, sharpnose, 733
 darter, shield, 736
 darter, slabrock, 694
 darter, slackwater, 630
 darter, slenderhead, 737
 darter, slough, 651
 darter, smallscale, 667
 darter, snail, 743
 darter, southern sand, 619
 darter, speckled, 697
 darter, spottail, 696
 darter, spotted, 664
 darter, stargazing, 744
 darter, strippled, 684
 darter, striated, 698
 darter, stripeback, 731
 darter, striped, 707
 darter, stripetail, 660
 darter, swamp, 650
 darter, Swannanoa, 700
 darter, tangerine, 716
 darter, teardrop, 626
 darter, Tennessee snubnose, 693
 darter, tessellated, 677
 darter, Tippecanoe, 703
 darter, trispot, 704

darter, turquoise, 655
 darter, Tuscumbia, 705
 darter, variegate, 706
 darter, Waccamaw, 681
 darter, watercress, 673
 darter, western sand, 618
 darter, yellow, 732
 darter, yellowcheek, 669
 darter, yoke, 658
 Dasyatidae, 37
Dasyatis sabina, 37
Diapterus plumieri, 751
Dionda diaboli, 153
Dionda episcopa, 154
 Dolly Varden, 115
Dormitator maculatus, 781
Dorosoma cepedianum, 69
Dorosoma petenense, 70
 drum, freshwater, 756
 drum, red, 761
 drums, 756
 E
 eel, American, 59
 eels, freshwater, 59
Elassoma evergladei, 584
Elassoma okefenokee, 585
Elassoma zonatum, 586
 Eleotridae, 781
Eleotris picta, 782
Eleotris pisonis, 783
 Elopidae, 55
Elops affinis, 55
Elops saurus, 56
 Embiotocidae, 776
Empetrichthys latos, 505
Empetrichthys merriami, 506
 Engraulidae, 73
Enneacanthus chaetodon, 587
Enneacanthus gloriosus, 588
Enneacanthus obesus, 589
 Ehippidae, 762
Eremichthys acros, 155
Ericymba buccata, 156
Erimyzon oblongus, 397
Erimyzon sucetta, 399
Erimyzon tenuis, 400
 Esocidae, 131
Esox americanus, 131
Esox lucius, 133
Esox masquinongy, 135
Esox niger, 137
Etheostoma acuticeps, 622
Etheostoma aquali, 623
Etheostoma asprigene, 624
Etheostoma atripinne, 625
Etheostoma barbouri, 626
Etheostoma bellum, 627
Etheostoma blennioides, 628
Etheostoma blennioides, 629
Etheostoma boschungii, 630
Etheostoma caeruleum, 631
Etheostoma camurum, 632
Etheostoma chlorobranchium, 633
Etheostoma chlorosomum, 634
Etheostoma cinereum, 635
Etheostoma collettei, 636
Etheostoma collis, 637
Etheostoma coosae, 638

Etheostoma cragini, 639
Etheostoma darisoni, 640
Etheostoma ditrema, 641
Etheostoma duryi, 642
Etheostoma edwini, 643
Etheostoma etnieri, 644
Etheostoma euzonum, 645
Etheostoma exile, 646
Etheostoma flabellare, 647
Etheostoma fonticola, 648
Etheostoma fricksium, 649
Etheostoma fusiforme, 650
Etheostoma gracile, 651
Etheostoma grahami, 652
Etheostoma hystrio, 653
Etheostoma hopkinsi, 654
Etheostoma inscriptum, 655
Etheostoma jessiae, 656
Etheostoma jordani, 657
Etheostoma juliae, 658
Etheostoma kanawhae, 659
Etheostoma kennicotti, 660
Etheostoma lepidum, 661
Etheostoma longimanum, 662
Etheostoma luteorinctum, 663
Etheostoma maculatum, 664
Etheostoma mariae, 665
Etheostoma meadiae, 666
Etheostoma microlepidum, 667
Etheostoma microperca, 668
Etheostoma moorei, 669
Etheostoma neopteron, 670
Etheostoma nanaquae, 671
Etheostoma nigrum, 672
Etheostoma nuchale, 673
Etheostoma obregonense, 674
Etheostoma okaloosae, 675
Etheostoma olivaceum, 676
Etheostoma olmstedii, 677
Etheostoma osburni, 678
Etheostoma pallididorsum, 679
Etheostoma parvipinnis, 680
Etheostoma perlongum, 681
Etheostoma podostemone, 682
Etheostoma proeliare, 683
Etheostoma punctulatum, 684
Etheostoma radiosum, 685
Etheostoma rubrum, 686
Etheostoma rufilineatum, 687
Etheostoma rupestre, 688
Etheostoma sagitta, 689
Etheostoma salmoides, 690
Etheostoma sellare, 691
Etheostoma serriferum, 692
Etheostoma simoteron, 693
Etheostoma smithi, 694
Etheostoma spectabile, 695
Etheostoma squamiceps, 696
Etheostoma stigmaeum, 697
Etheostoma striatulum, 698
Etheostoma swaini, 699
Etheostoma swainsonae, 700
Etheostoma tetrazonum, 701
Etheostoma thalassinum, 702
Etheostoma tippecanoe, 703
Etheostoma trisella, 704
Etheostoma tuscumbia, 705
Etheostoma variatum, 706

Etheostoma virgatum, 707
Etheostoma vitreum, 708
Etheostoma whipplei, 709
Etheostoma zonale, 710
Etheostoma zoniferum, 711
Eucinostomus argenteus, 752
Eucyclogobius newberryi, 788
eulachon, 126
Eroglossum laurae, 157
Eroglossum macrilingus, 158

F

fallfish, 362
 firemouth, 766
 flagfish, 532
 flier, 583
 flounder, southern, 829
 flounder, starry, 830
 flounders, lefteye, 828
 flounders, righteye, 830
Fundulus albolineatus, 507
Fundulus blairae, 508
Fundulus catenatus, 509
Fundulus chrysotus, 510
Fundulus eimgulatus, 511
Fundulus confluentus, 512
Fundulus diaphanus, 513
Fundulus dispar, 514
Fundulus escambiae, 515
Fundulus grandis, 516
Fundulus heteroclitus, 517
Fundulus jenkinsi, 518
Fundulus lineolatus, 519
Fundulus luciae, 520
Fundulus notatus, 521
Fundulus notti, 522
Fundulus olivaceus, 523
Fundulus parvipinnis, 524
Fundulus pulvereus, 525
Fundulus rathbuni, 526
Fundulus seiadicus, 527
Fundulus seminolis, 528
Fundulus stellifer, 529
Fundulus uaccaeensis, 530
Fundulus zebrinus, 531

G

Gadidae, 487
Gambusia affinis, 538
Gambusia amistadensis, 539
 gambusia, Big Bend, 540
 gambusia, blotched, 546
 gambusia, Clear Creek, 543
Gambusia gaigei, 540
Gambusia geisleri, 541
Gambusia georgei, 542
 gambusia, Goodenough, 539
Gambusia heterochir, 543
 gambusia, largespring, 541
 gambusia, mangrove, 545
Gambusia nobilis, 544
 gambusia, Pecos, 544
Gambusia rhizophorae, 545
 gambusia, San Marcos, 542
Gambusia senilis, 546
 gar, alligator, 47
 gar, Florida, 51
 gar, longnose, 49
 gar, shortnose, 50

gar, spotted, 48
gars, 47
Gasterosteidae, 561
Gasterosteus aculeatus, 563
Gasterosteus wheatlandi, 565
Gerreidae, 751
Gila alvordensis, 159
Gila atraria, 160
Gila bicolor, 161
Gila coerulea, 162
Gila copei, 163
Gila crassicauda, 164
Gila cypha, 165
Gila ditaenia, 166
Gila elegans, 167
Gila nigrescens, 168
Gila orcutti, 169
Gila pandora, 170
Gila purpurea, 171
Gila robusta, 172
Gillichthys mirabilis, 789
gobies, 785
Gobiidae, 785
Gobioides broussoneti, 790
Gobiomorus dormitor, 784
Gobionellus atripinnis, 791
Gobionellus boleosoma, 792
Gobionellus pseudofasciatus, 793
Gobionellus shufeldti, 794
Gobiosoma bosci, 795
Gobiosoma robustum, 796
goby, arrow, 787
goby, blackfin, 791
goby, clown, 797
goby, code, 796
goby, darter, 792
goby, freshwater, 794
goby, green, 798
goby, naked, 795
goby, river, 786
goby, slashcheek, 793
goby, tidewater, 788
goby, violet, 790
goby, yellowfin, 785
goldeye, 74
goldfish, 147
gourami, croaking, 799
gouramies, 799
grayling, Arctic, 120
grunts, 753
guppy, 550

H

hardhead, 209
Harengula jaguana, 71
Hemichromis bimaculatus, 770
Hemitremia flammea, 173
herring, Atlantic thread, 72
herring, blueback, 61
herring, lake, 77
herring, skipjack, 63
herrings, 61
Heterandria formosa, 547
Hiodon alosoides, 74
Hiodon tergisus, 75
Hiodontidae, 74
hitch, 199
hogchoker, 831

Hybognathus argyritis, 174
Hybognathus hankinsoni, 175
Hybognathus hayi, 176
Hybognathus nuchalis, 177
Hybognathus placitus, 178
Hybognathus regius, 179
Hybopsis aestivalis, 180
Hybopsis amblops, 181
Hybopsis cahni, 182
Hybopsis crameri, 183
Hybopsis dissimilis, 184
Hybopsis gelida, 185
Hybopsis gracilis, 186
Hybopsis hypsinotus, 187
Hybopsis insignis, 188
Hybopsis labrosa, 189
Hybopsis lineapunctata, 190
Hybopsis meeki, 191
Hybopsis monacha, 192
Hybopsis rubrifrons, 193
Hybopsis storeriana, 194
Hybopsis winchelli, 195
Hybopsis x-punctata, 196
Hybopsis zanema, 197
Hypentelium etowanum, 401
Hypentelium nigricans, 402
Hypentelium roanokense, 403
Hypomesus olidus, 121
Hypomesus pretiosus, 122
Hypomesus transpacificus, 123
Hypostomus, 477
Hysteroecarpus traski, 777

I

Ichthyomyzon bdellium, 15
Ichthyomyzon castaneus, 16
Ichthyomyzon fossor, 17
Ichthyomyzon gagei, 18
Ichthyomyzon greeleyi, 19
Ichthyomyzon unicuspis, 20
Ictaluridae, 437
Ictalurus brunneus, 437
Ictalurus catus, 438
Ictalurus furcatus, 439
Ictalurus lupus, 440
Ictalurus melas, 441
Ictalurus natalis, 442
Ictalurus nebulosus, 443
Ictalurus platycephalus, 444
Ictalurus pricei, 445
Ictalurus punctatus, 446
Ictalurus serracanthus, 447
Ictiobus bubalus, 404
Ictiobus cyprinellus, 405
Ictiobus niger, 406
ide, 205
inconnu, 119
Iotichthys phlegethontis, 198

J

jack, crevalle, 749
Jack Dempsey, 768
jacks, 749
jewelfish, 770
Jordanella floridae, 532
jumprock, bigeye, 411
jumprock, black, 417
jumprock, greater, 425
jumprock, striped, 433

K

killifish, Ash Meadows, 506
 killifish, banded, 513
 killifish, Bayou, 525
 killifish, bluefin, 534
 killifish, California, 524
 killifish, Gulf, 516
 killifish, least, 547
 killifish, marsh, 512
 killifish, Pahrump, 505
 killifish, pike, 537
 killifish, plains, 531
 killifish, pygmy, 533
 killifish, rainwater, 535
 killifish, Seminole, 528
 killifish, speckled, 526
 killifish, spotfin, 520
 killifish, Waccamaw, 530
 killifishes, 491
 kiyi, 83

L

Labidesthes sicculus, 557
 ladyfish, 56
Lagochila lacera, 407
Lagodon rhomboides, 755
Lampetra aepyptera, 21
Lampetra alaskense, 22
Lampetra appendix, 23
Lampetra ayresi, 24
Lampetra folletti, 25
Lampetra hubbsi, 26
Lampetra japonica, 27
Lampetra lethophaga, 28
Lampetra meridionale, 29
Lampetra minima, 30
Lampetra pacifica, 31
Lampetra richardsoni, 32
Lampetra similis, 33
Lampetra tridentata, 34
 lamprey, Allegheny brook, 19
 lamprey, American brook, 23
 lamprey, Arctic, 27
 lamprey, chestnut, 16
 lamprey, darktail, 22
 lamprey, Gulf brook, 29
 lamprey, Kern brook, 26
 lamprey, Klamath river, 33
 lamprey, least brook, 21
 lamprey, Miller lake, 30
 lamprey, northern brook, 17
 lamprey, Ohio, 15
 lamprey, Pacific, 34
 lamprey, Pacific brook, 31
 lamprey, Pit-Klamath brook, 28
 lamprey, river, 24
 lamprey, sea, 35
 lamprey, silver, 20
 lamprey, southern brook, 18
 lamprey, western brook, 32
 lampreys, 15
Lavinia exilicauda, 199
Lavinia symmetricus, 200
Leiostomus xanthurus, 759
Lepidomeda albivallis, 201
Lepidomeda altivelis, 202
Lepidomeda mollispinis, 203
Lepidomeda vittata, 204

Lepisosteidae, 47
Lepisosteus oculatus, 48
Lepisosteus osseus, 49
Lepisosteus platostomus, 50
Lepisosteus platyrhincus, 51
Lepomis auritus, 590
Lepomis cyanellus, 591
Lepomis gibbosus, 593
Lepomis gulosus, 595
Lepomis humilis, 596
Lepomis macrochirus, 597
Lepomis marginatus, 599
Lepomis megalotis, 600
Lepomis microlophus, 601
Lepomis punctatus, 602
Lepomis symmetricus, 603
Leptocottus armatus, 825
Leptolucania ommata, 533
Leuciscus idus, 205
 livebearer, porthole, 552
 livebearers, 537
 loaches, 436
 logperch, 719
 logperch, bigscale, 727
 logperch, blotchside, 718
 logperch, Roanoke, 738
Loricariidae, 477
Lota lota, 487
Lucania goodei, 534
Lucania parva, 535
Lutjanidae, 750
Lutjanus griseus, 750

M

machete, 55
 madtom, black, 456
 madtom, brindled, 464
 madtom, brown, 467
 madtom, Caddo, 470
 madtom, Carolina, 457
 madtom, checkered, 453
 madtom, elegant, 450
 madtom, frecklebelly, 465
 madtom, freckled, 466
 madtom, least, 460
 madtom, margined, 461
 madtom, mountain, 451
 madtom, Neosho, 468
 madtom, northern, 469
 madtom, orangefin, 458
 madtom, Ouachita, 462
 madtom, Ozark, 448
 madtom, Scioto, 471
 madtom, slender, 452
 madtom, smokey, 449
 madtom, speckled, 463
 madtom, tadpole, 459
 madtom, yellowfin, 454
Meda fulgida, 206
 medaka, 490
 medakas, 490
Megalops atlanticus, 57
Menidia bergyllina, 558
Menidia extensa, 559
Menidia menidia, 560
Microgadus tomcod, 488
Microgobius gulosus, 797
Microgobius thalassinus, 798
Micropogonias undulatus, 760

- Micropterus coosae*, 604
Micropterus dolomieu, 605
Micropterus notius, 606
Micropterus punctulatus, 607
Micropterus salmoides, 608
Micropterus treculi, 609
minnow, bluntnose, 340
minnow, brassy, 175
minnow, bullhead, 343
minnow, central silvery, 177
minnow, cutlips, 158
minnow, cypress, 176
minnow, Devils River, 153
minnow, eastern silvery, 179
minnow, fathead, 341
minnow, flatlips, 331
minnow, Kanawha, 333
minnow, loach, 365
minnow, Ozark, 289
minnow, plains, 178
minnow, pugnose, 262
minnow, riffle, 330
minnow, roundnose, 154
minnow, sheephead, 504
minnow, silverjaw, 156
minnow, slim, 342
minnow, stargazing, 334
minnow, suckermouth, 332
minnow, tonguetied, 157
minnow, western silvery, 174
minnows, 140
Minytrema mclanops, 408
Misgurnus anguillicaudatus, 436
Moapa coriacea, 207
mojarra, spotfin, 752
mojarra, striped, 751
mojarras, 751
molly, Amazon, 548
molly, sailfin, 549
molly, shortfin, 551
mooneye, 75
mooneyes, 74
Morone americana, 573
Morone chrysops, 574
Morone mississippiensis, 575
Morone saxatilis, 576
mosquitofish, 538
Morostoma anisurum, 409
Morostoma ariommum, 411
Morostoma atripinne, 412
Morostoma austrinum, 413
Morostoma carinatum, 415
Morostoma cervinum, 417
Morostoma congestum, 418
Morostoma duquesnei, 419
Morostoma erythrurum, 421
Morostoma hamiltoni, 423
Morostoma hubbsi, 424
Morostoma lachneri, 425
Morostoma macrolepidotum, 427
Morostoma pappilosum, 429
Morostoma poecilurum, 430
Morostoma rhothoecum, 431
Morostoma robustum, 432
Morostoma rupiscartes, 433
Morostoma valenciennesi, 434
mudminnow, central, 129
mudminnow, eastern, 130
mudminnow, Olympic, 128
mudminnows, 127
mudsucker, longjaw, 789
Mugil cephalus, 779
Mugil curema, 780
Mugilidae, 778
mullet, mountain, 778
mullet, striped, 779
mullet, white, 780
mulletts, 778
mummichog, 517
muskellunge, 135
Mylocheilus caurinus, 208
Mylopharodon conocephalus, 209
Myoxocephalus quadricornis, 826
Myoxocephalus thompsoni, 827
N
needlefish, Atlantic, 489
needlefishes, 489
Nocomis asper, 210
Nocomis biguttatus, 211
Nocomis effusus, 212
Nocomis leptcephalus, 213
Nocomis micropogon, 215
Nocomis platyrhynchus, 217
Nocomis raneyi, 218
Notemigonus crysoleucas, 219
Notropis albeolus, 220
Notropis alborus, 221
Notropis altipinnis, 222
Notropis amabilis, 223
Notropis amnis, 224
Notropis amoenus, 225
Notropis analostanus, 226
Notropis anogenus, 227
Notropis ardens, 228
Notropis ariommus, 229
Notropis asperifrons, 230
Notropis atherinoides, 231
Notropis atripiculus, 233
Notropis atrocaudalis, 234
Notropis baileyi, 235
Notropis bairdi, 236
Notropis bellus, 237
Notropis bifrenatus, 238
Notropis blennius, 239
Notropis boops, 240
Notropis braytoni, 241
Notropis buccula, 242
Notropis buechanani, 243
Notropis caeruleus, 244
Notropis callisema, 245
Notropis callistius, 246
Notropis callitaenia, 247
Notropis camurus, 248
Notropis cerasinus, 249
Notropis chalybaeus, 250
Notropis chihuahua, 251
Notropis chiliticus, 252
Notropis chloristius, 253
Notropis chlorocephalus, 254
Notropis chrosomus, 255
Notropis chrysocephalus, 256
Notropis coccogenis, 257
Notropis cornutus, 258
Notropis cummingsae, 259
Notropis dorsalis, 260
Notropis edwardraneyi, 261

Notropis emiliae, 262
Notropis euryzonus, 263
Notropis formosus, 264
Notropis fumeus, 265
Notropis galacturus, 266
Notropis gibbsi, 267
Notropis girardi, 268
Notropis greeniei, 269
Notropis harperi, 270
Notropis heterodon, 271
Notropis heterolepis, 272
Notropis hubbsi, 273
Notropis hudsonius, 275
Notropis hypselopterus, 277
Notropis hypsilepis, 278
Notropis jemezianus, 279
Notropis leedsi, 280
Notropis leuciodus, 281
Notropis lirus, 282
Notropis longirostris, 283
Notropis lutipinnis, 284
Notropis lutrensis, 285
Notropis maculatus, 286
Notropis mekistocholas, 287
Notropis niveus, 288
Notropis nubilus, 289
Notropis ortenburgeri, 290
Notropis oxyrhynchus, 291
Notropis ozarcanus, 292
Notropis perpallidus, 293
Notropis petersoni, 294
Notropis photogenis, 295
Notropis pilsbryi, 296
Notropis potteri, 297
Notropis procne, 298
Notropis proserpinus, 299
Notropis pyrrhomelas, 300
Notropis roseipinnis, 301
Notropis rubellus, 302
Notropis rubricroceus, 303
Notropis sabiniae, 304
Notropis scabriceps, 305
Notropis scepticus, 306
Notropis semperasper, 307
Notropis shumardi, 308
Notropis signipinnis, 309
Notropis simus, 310
Notropis spectrunculus, 311
Notropis spilopterus, 312
Notropis stilbius, 313
Notropis stramineus, 314
Notropis telescopus, 315
Notropis texanus, 316
Notropis topeka, 317
Notropis trichroistius, 318
Notropis umbratilis, 319
Notropis uranoscopus, 320
Notropis venustus, 321
Notropis volucellus, 322
Notropis welaka, 323
Notropis whipplei, 324
Notropis xanocephalus, 325
Notropis xanurus, 326
Notropis zonatus, 327
Notropis zonistius, 328
Noturus albatel, 448
Noturus baileyi, 449
Noturus elegans, 450

Noturus cleatherus, 451
Noturus exilis, 452
Noturus flavater, 453
Noturus flavipinnis, 454
Noturus flavus, 455
Noturus funebris, 456
Noturus furiosus, 457
Noturus gilberti, 458
Noturus gyrinus, 459
Noturus hildebrandi, 460
Noturus insignis, 461
Noturus lachneri, 462
Noturus leptacanthus, 463
Noturus minurus, 464
Noturus miurus, 464
Noturus nocturnus, 466
Noturus phaeus, 467
Noturus placidus, 468
Noturus stigmatosus, 469
Noturus taylora, 470
Noturus trautmani, 471
Nocumbra hubbsi, 128
O
Oncorhynchus gorboscha, 92
Oncorhynchus keta, 93
Oncorhynchus kisutch, 94
Oncorhynchus nerka, 95
Oncorhynchus tshawytscha, 96
Oostethus brachyurus, 567
Opisthonema oglinum, 72
Orthodon microlepidotus, 329
Orthopristis chrysoptera, 753
Oryzias latipes, 490
Oryziatidae, 490
oscar, 763
Osmeridae, 121
Osmerus mordax, 124
P
paddlefish, 45
paddlefishes, 45
Paralichthys lethostigma, 829
peamouth, 208
Perca flavescens, 713
perch, pirate, 484
perch, Rio Grande, 765
perch, Sacramento, 582
perch, shiner, 776
perch, silver, 757
perch, tule, 777
perch, white, 573
perch, yellow, 713
perches, 615
perches, pirate, 484
Percichthyidae, 573
Percidae, 615
Percina antesella, 715
Percina aurantiaca, 716
Percina aurolineata, 717
Percina burtoni, 718
Percina caprodes, 719
Percina copelandi, 721
Percina crassa, 722
Percina cymatotaenia, 723
Percina evides, 724
Percina lenticula, 725
Percina macrocephala, 726
Percina macrolepidota, 727
Percina maculata, 728

Percina nasuta, 729
Percina nigrofasciata, 730
Percina notogramma, 731
Percina ouachitae, 732
Percina oxyrhyncha, 733
Percina palmaris, 734
Percina pantherina, 735
Percina peltata, 736
Percina phoxocephala, 737
Percina rex, 738
Percina roanoka, 739
Percina sciera, 740
Percina shumardi, 741
Percina squamata, 742
Percina tanasi, 743
Percina uranidea, 744
Percopsidae, 485
Percopsis omiscomaycus, 485
Percopsis transmontana, 486
Petromyzon marinus, 35
Petromyzontidae, 15
Phenacobius catostomus, 330
Phenacobius crassilabrum, 331
Phenacobius mirabilis, 332
Phenacobius teretulus, 333
Phenacobius uranops, 334
Phorinus cumberlandensis, 335
Phorinus eos, 336
Phorinus erythrogaster, 337
Phorinus neogaeus, 338
Phorinus oreas, 339
pickerel, chain, 137
pickerel, grass, 131
pickerel, redfin, 131
pigfish, 753
pike, northern, 133
pikes, 131
Pimephales notatus, 340
Pimephales promelas, 341
Pimephales tenellus, 342
Pimephales rigilar, 343
pinfish, 755
pipefish, Gulf, 568
pipefish, opossum, 567
pipefishes, 567
Plagiopterus argentissimus, 344
Platichthys stellatus, 830
platyfish, southern, 555
platyfish, variable, 556
Pleuronectidae, 830
Poecilia formosa, 548
Poecilia latipinna, 549
Poecilia reticulata, 550
Poecilia sphenops, 551
Poeciliidae, 537
Poeciliopsis gracilis, 552
Poeciliopsis occidentalis, 553
Pogonichthys ciscoides, 345
Pogonichthys macrolepidotus, 346
Polyodon spathula, 45
Polyodontidae, 45
Pomadasyidae, 753
Pomoxis annularis, 611
Pomoxis nigromaculatus, 613
porgies, 754
Prosopium abyssicola, 97
Prosopium coulteri, 98
Prosopium cylindraceum, 99

Prosopium gemmiferum, 100
Prosopium spilonotus, 101
Prosopium williamsoni, 102
Ptychocheilus grandis, 347
Ptychocheilus lucius, 348
Ptychocheilus oregonensis, 349
Ptychocheilus umpqua, 350
pumpkinseed, 593
Pungitius pungitius, 566
pupfish, Armagosa, 498
pupfish, Comanche Springs, 495
pupfish, Conchos, 496
pupfish, desert, 497
pupfish, Devils Hole, 494
pupfish, Leon Springs, 493
pupfish, Owens, 500
pupfish, Pecos River, 499
pupfish, Red River, 501
pupfish, Salt Creek, 502
pupfish, white sands, 503
Pyloodictis olivaris, 472
Q
quillback, 368
R
redhorse, black, 419
redhorse, blacktail, 430
redhorse, copper, 424
redhorse, golden, 421
redhorse, gray, 418
redhorse, greater, 434
redhorse, river, 415
redhorse, shorthead, 427
redhorse, silver, 409
redhorse, smallfin, 432
redhorse, V-lip, 429
redhorse, West Mexican, 413
Relictus solitarius, 351
Rhinichthys atratulus, 352
Rhinichthys cataractae, 353
Rhinichthys evermanni, 354
Rhinichthys falcatus, 355
Rhinichthys osculus, 356
Rhodeus sericeus, 357
Richardsonius balteatus, 358
Richardsonius egregius, 359
rivulus, 536
Rivulus marmoratus, 536
roach, California, 200
rockbass, Ozark, 580
roller, sand, 486
rudd, 360
S
Salmo aguabonita, 103
Salmo apache, 104
Salmo clarki, 105
Salmo gairdneri, 106
Salmo gilae, 107
Salmo salar, 108
Salmo trutta, 109
salmon, Atlantic, 108
salmon, chinook, 96
salmon, chum, 93
salmon, coho, 94
salmon, pink, 92
salmon, sockeye, 95
Salmonidae, 76
Salvelinus agassizi, 110
Salvelinus alpinus, 111

Salvelinus anakturukensis, 112
Salvelinus confluentus, 113
Salvelinus fontinalis, 114
Salvelinus malma, 115
Salvelinus namaycush, 117
sardine, scaled, 71
Satan eurystomus, 473
sauger, 745
Scaphirhynchus albus, 43
Scaphirhynchus platorhynchus, 44
Scardinius erythrophthalmus, 360
Sciaenidae, 756
Sciaenops ocellata, 761
sculpin, banded, 807
sculpin, Bear Lake, 811
sculpin, black, 804
sculpin, coastrange, 801
sculpin, deepwater, 827
sculpin, fourhorn, 826
sculpin, Klamath Lake, 820
sculpin, marbled, 815
sculpin, margined, 817
sculpin, mottled, 805
sculpin, Pacific staghorn, 825
sculpin, Pit, 819
sculpin, Piute, 806
sculpin, Potomac, 812
sculpin, prickly, 802
sculpin, pygmy, 821
sculpin, reticulate, 818
sculpin, riffle, 814
sculpin, rough, 803
sculpin, sharpnose, 800
sculpin, shorthead, 809
sculpin, Shoshone, 813
sculpin, slender, 824
sculpin, slimy, 808
sculpin, spoonhead, 823
sculpin, torrent, 822
sculpin, Utah Lake, 810
sculpin, Wood River, 816
sculpins, 800
seatrout, spotted, 758
Semotilus atromaculatus, 361
Semotilus corporalis, 362
Semotilus lumbee, 363
Semotilus margarita, 364
shad, Alabama, 62
shad, American, 67
shad, gizzard, 69
shad, hickory, 64
shad, threadfin, 70
shark, bull, 36
sharks, requiem, 36
sheepshead, 754
shiner, Alabama, 246
shiner, Altamaha, 326
shiner, Arkansas River, 268
shiner, bandfin, 328
shiner, bannerfin, 280
shiner, beautiful, 264
shiner, bigeye, 240
shiner, bigmouth, 260
shiner, blackchin, 271
shiner, blacknose, 272
shiner, blackspot, 234
shiner, blacktail, 321
shiner, blacktip, 233
shiner, bleeding, 327
shiner, blue, 244
shiner, bluehead, 273
shiner, bluenose, 323
shiner, bluestripe, 247
shiner, bluntface, 248
shiner, bluntnose, 310
shiner, bridle, 238
shiner, broadstripe, 263
shiner, burrhead, 230
shiner, Cape Fear, 287
shiner, cherryfin, 301
shiner, Chihuahua, 251
shiner, chub, 297
shiner, coastal, 294
shiner, comely, 225
shiner, common, 258
shiner, Coosa, 325
shiner, crescent, 249
shiner, dusky, 259
shiner, duskystripe, 296
shiner, emerald, 231
shiner, fieryblack, 300
shiner, flagfin, 309
shiner, fluvial, 261
shiner, ghost, 243
shiner, golden, 219
shiner, greenfin, 253
shiner, greenhead, 254
shiner, highfin, 222
shiner, highscale, 278
shiner, invisible, 274
shiner, ironcolor, 250
shiner, Kiamichi, 290
shiner, Lahontan redbside, 359
shiner, longnose, 283
shiner, mimic, 322
shiner, mirror, 311
shiner, mountain, 282
shiner, New River, 305
shiner, Ocmulgee, 245
shiner, Ozark, 292
shiner, pallid, 224
shiner, peppered, 293
shiner, popeye, 229
shiner, pretty, 237
shiner, proserpine, 299
shiner, pugnose, 227
shiner, rainbow, 255
shiner, red, 285
shiner, Red River, 236
shiner, redfin, 319
shiner, redlip, 252
shiner, redbside, 358
shiner, ribbon, 265
shiner, Rio Grande, 279
shiner, river, 239
shiner, rosefin, 228
shiner, rosyface, 302
shiner, rough, 235
shiner, roughhead, 307
shiner, Sabine, 304
shiner, saffron, 303
shiner, sailfin, 277
shiner, sand, 314
shiner, sandbar, 306
shiner, satinfin, 226

shiner, sharpnose, 291
 shiner, silver, 295
 shiner, silverband, 308
 shiner, silverstripe, 313
 shiner, skygazer, 320
 shiner, smalleye, 242
 shiner, spotfin, 312
 shiner, spottail, 275
 shiner, steelcolor, 324
 shiner, striped, 256
 shiner, swallowtail, 298
 shiner, taillight, 286
 shiner, Tallapoosa, 267
 shiner, Tamaulipas, 241
 shiner, telescope, 315
 shiner, Tennessee, 281
 shiner, Texas, 223
 shiner, Topeka, 317
 shiner, tricolor, 318
 shiner, warpaint, 257
 shiner, wedgespot, 269
 shiner, weed, 316
 shiner, white, 220
 shiner, whitefin, 288
 shiner, whitemouth, 221
 shiner, whitetail, 266
 shiner, yellowfin, 284
 silverside, Atlantic, 560
 silverside, brook, 557
 silverside, tidewater, 558
 silverside, Waccamaw, 559
 silversides, 557
 sleeper, bigmouth, 784
 sleeper, fat, 781
 sleeper, spinycheek, 783
 sleeper, spotted, 782
 sleepers, 781
 smelt, Delta, 123
 smelt, longfin, 125
 smelt, pond, 121
 smelt, rainbow, 124
 smelt, surf, 122
 smelts, 121
 snapper, gray, 750
 snappers, 750
 snook, 572
 snook, fat, 570
 snook, swordspine, 569
 snook, tarpon, 571
 snooks, 569
 Soleidae, 831
 soles, 831
 spadefish, Atlantic, 762
 spadefishes, 762
 Sparidae, 754
Speoplatyrhinus poulsoni, 482
 spikedace, 206
 spinedace, Little Colorado, 204
 spinedace, Pahrnagat, 202
 spinedace, Virgin, 203
 spinedace, White River, 201
Spirinchus thaleichthys, 125
 splittail, 346
 splittail, Clear Lake, 345
 spot, 759
 springfish, Railroad Valley, 492
 springfish, White River, 491
 squawfish, Colorado, 348

squawfish, northern, 349
 squawfish, Sacramento, 347
 squawfish, Umpqua, 350
Stenodus leucichthys, 119
 stickleback, blackspotted, 565
 stickleback, brook, 562
 stickleback, fourspine, 561
 stickleback, ninespine, 566
 stickleback, threespine, 563
 sticklebacks, 561
 stingray, Atlantic, 37
 stingrays, 37
Stizostedion canadense, 745
Stizostedion vitreum, 747
 stonecat, 455
 stoneroller, 143
 stoneroller, largescale, 145
 stoneroller, Mexican, 146
Strongylura marina, 489
 studfish, northern, 509
 studfish, southern, 529
 sturgeon, Atlantic, 41
 sturgeon, green, 40
 sturgeon, lake, 39
 sturgeon, pallid, 43
 sturgeon, shortnose, 38
 sturgeon, shovelnose, 44
 sturgeon, white, 42
 sturgeons, 38
 sucker, Alabama hog, 401
 sucker, blackfin, 412
 sucker, blue, 396
 sucker, bluehead, 377
 sucker, bridgelip, 374
 sucker, desert, 373
 sucker, flannelmouth, 381
 sucker, harelip, 407
 sucker, humpback, 435
 sucker, June, 395
 sucker, Klamath largescale, 390
 sucker, Klamath smallscale, 388
 sucker, largescale, 383
 sucker, longnose, 372
 sucker, Lost River, 382
 sucker, Modoc, 384
 sucker, mountain, 386
 sucker, northern hog, 402
 sucker, Owens, 379
 sucker, Rio Grande, 387
 sucker, Roanoke hog, 403
 sucker, rustyside, 423
 sucker, Sacramento, 385
 sucker, Santa Ana, 389
 sucker, shortnose, 393
 sucker, Sonora, 380
 sucker, spotted, 408
 sucker, Tahoe, 391
 sucker, torrent, 431
 sucker, Utah, 370
 sucker, Warner, 392
 sucker, webbug, 378
 sucker, white, 375
 sucker, Yaqui, 371
 suckers, 367
 sunfish, banded, 589
 sunfish, banded pygmy, 586
 sunfish, bantam, 603
 sunfish, blackbanded, 587

sunfish, bluespotted, 588
 sunfish, dollar, 599
 sunfish, Everglades pygmy, 584
 sunfish, green, 591
 sunfish, longear, 600
 sunfish, mud, 577
 sunfish, Okefenokee pygmy, 585
 sunfish, orangespotted, 596
 sunfish, redbreast, 590
 sunfish, redear, 601
 sunfish, spotted, 602
 sunfishes, 577
 surfperches, 776
 swampfish, 481
 swordtail, green, 554
 Syngnathidae, 567
Syngnathus scovelli, 568
T
 tarpon, 57
 tarpons, 55
 tench, 366
 tetra, Mexican, 139
Thaleichthys pacificus, 126
Thymallus arcticus, 120
Tiaroga cobitis, 365
Tilapia aurea, 771
 tilapia, blackchin, 773
 tilapia, blue, 771
Tilapia mariae, 772
Tilapia melanotheron, 773
Tilapia mossambica, 774
 tilapia, Mozambique, 774
 tilapia, redbelly, 775
 tilapia, spotted, 772
Tilapia zilli, 775
Tinca tinca, 366
 tomcod, Atlantic, 488
 topminnow, banded, 511
 topminnow, blackspotted, 523
 topminnow, blackstripe, 521
 topminnow, Blair's starhead, 508
 topminnow, eastern starhead, 515
 topminnow, Gila, 553
 topminnow, golden, 510
 topminnow, lined, 519
 topminnow, northern starhead, 514
 topminnow, plains, 527
 topminnow, saltmarsh, 518
 topminnow, starhead, 522
 topminnow, whiteline, 507
Trichopsis vittatus, 799
Trinectes maculatus, 831
Trogloglanis pattersoni, 474
 trout, Arizona, 104
 trout, brook, 114
 trout, brown, 109
 trout, bull, 113
 trout, cutthroat, 105
 trout, Gila, 107
 trout, golden, 103
 trout, lake, 117
 trout, rainbow, 106
 trout, silver, 110
 trout-perch, 485
 trout-perches, 485
 trouts, 76
Typhlichthys subterraneus, 483

U
Umbra limi, 129
Umbra pygmaca, 130
 Umbridae, 127
W
 walleye, 747
 warmouth, 595
 weatherfish, Oriental, 436
 whiff, bay, 828
 whitefish, Atlantic, 79
 whitefish, Bear Lake, 97
 whitefish, Bonneville, 101
 whitefish, broad, 85
 whitefish, humpback, 88
 whitefish, lake, 80
 whitefish, mountain, 102
 whitefish, pygmy, 98
 whitefish, round, 99
 woundfin, 344
X
Xiphophorus hellerii, 554
Xiphophorus maculatus, 555
Xiphophorus variatus, 556
Xyrauchen texanus, 435

PUBLICATIONS OF THE NORTH CAROLINA BIOLOGICAL SURVEY — 1980

- | | |
|--|---------|
| Clamp, John C. A New <i>Ellobiophyra</i> species (Ciliophora) symbiotic on the Ectoproct, <i>Bugula neritina</i> . (Abstract). ASB Bulletin 27(2):27. | 1980-1 |
| Cooper, Martha R., and Horton H. Hobbs, Jr. New and Little-known Crayfishes of the <i>virilis</i> Section of Genus <i>Orconectes</i> (Decapoda: Cambaridae) from the Southeastern United States. Smithsonian Contributions to Zoology, No. 310:1-44. | 1980-2 |
| LeGrand, Harry E. Jr., and Eloise F. Potter. Ashe County breeding bird foray—1979. The Chat 44(1):5-13. | 1980-3 |
| Potter, Eloise F. Notes on nesting Yellow-billed Cuckoos. Journal of Field Ornithology 51(1):17-29. | 1980-4 |
| Potter, Eloise F., and Harry E. LeGrand, Jr. Bird finding on Roan Mountain, Mitchell County, NC. The Chat 44(2):32-36. | 1980-5 |
| Shelley, Rowland M. Revision of the milliped genus <i>Pleurolooma</i> (Polydesmida: Xystodesmidae). Canadian Journal of Zoology 58:129-168. | 1980-6 |
| Potter, Eloise F., and Paul W. Sykes Jr. A probable Swainson's Hawk from Tyrrell County, NC, with comments on a fall 1965 sighting from the Outer Banks. The Chat 44(3):76-78. | 1980-7 |
| Lee, David S. Supplement to the 1978 Checklist of North Carolina Birds. The Chat 44(3):59-61. | 1980-8 |
| Lee, David S. Probable sight records of an Ivory Gull in North Carolina. The Chat 44(4):105-106. | 1980-9 |
| Lee, David S. Distraction display of Chipping Sparrow. The Chat 44(4):111-112. | 1980-10 |
| Palmer, William M., and Alvin L. Braswell. Additional records of albinistic amphibians and reptiles from North Carolina. Brimleyana (3):49-52. | 1980-11 |
| Lee, David S., Carter R. Gilbert, Charles H. Hocutt, Robert E. Jenkins, Don E. McAllister, and Jay R. Stauffer, Jr. <i>Atlas of North American Freshwater Fishes</i> . N.C. State Museum of Natural History, Raleigh. i-x +854 pp. | 1980-12 |
| Shelly, Rowland M. The status of <i>Cleptoria shelfordi</i> Loomis, with the proposal of a new milliped genus in the milliped family Xystodesmidae (Polydesmida). Brimleyana (3):31-41. | 1980-13 |
| Shelley, Rowland M., and Marianne Filka. Structure of the gonopod primordia of the milliped <i>Sigmoria latior</i> (Brolemann) (Polydesmida: Xystodesmidae). Transactions of the American Microscopical Society 99:173-179. | 1980-14 |
| Robinson, Sarah S., and David S. Lee. Recent range expansion of the Groundhog, <i>Marmota monax</i> , in the Southeast. Brimleyana (3):43-48. | 1980-15 |
| Lee, David S. Observations of Black-capped Petrels in North Carolina waters (Abstract). 98th Annual Meeting of the American Ornithologists Union. | 1980-16 |
| Whaling, Patrick J., David S. Lee, Joseph Bonaventura, and Michael Rentzepis. The body burden approach of looking at natural mercury accumulation in pelagic seabirds. (Abstract). 98th Annual Meeting of the American Ornithologists Union. | 1980-17 |

- Shelly, Rowland M., and Marianne Filka. The diplopod fauna of the Kings Mountain region of North Carolina. *Brimleyana* (4):1-42. 1980-18
- Lee, David S., and Guy W. Oliver. Impact assessment of Manteo (Shallowbag) Bay, NC. Project on marine mammals and sea turtles. U.S. Army Corps of Engineers, Wilmington District, 14 pp., +4 tables. 1980-19
- Lee, David S., and Steven P. Platania. Observations of Leatherback Turtles in North Carolina's offshore waters (Abstract). 60th Annual meeting of the American Society Ichthyologists and Herpetologists. 1980-20
- Fussell, John O., and Alice Allen-Grimes. Bird sightings associated with Hurricane David. *The Chat* 44(4):89-100. 1980-21

